



2005 Data Summary Report

July 2006



Grasse River Study Area
Massena, New York



ALCOA

Alcoa Inc.
Massena, New York

TABLE OF CONTENTS

| | |
|--|------------|
| SECTION 1 INTRODUCTION..... | 1-1 |
| SECTION 2 2005 SRS PROGRAM | 2-1 |
| 2.1 ROUTINE WATER COLUMN MONITORING | 2-1 |
| 2.1.1 Collection Summary..... | 2-1 |
| 2.1.2 Results | 2-3 |
| 2.1.2.1 River Flow and Precipitation | 2-3 |
| 2.1.2.2 Water Quality | 2-4 |
| 2.1.2.3 PCBs..... | 2-5 |
| 2.1.2.4 Comparison to Historic Data..... | 2-7 |
| 2.2 RESIDENT FISH TREND MONITORING SURVEY | 2-8 |
| 2.2.1 Collection Summary..... | 2-8 |
| 2.2.2 Results | 2-9 |
| 2.2.2.1 PCB Results | 2-9 |
| 2.2.2.2 Comparison to Historic Data..... | 2-11 |
| SECTION 3 2005 FOCUSED STUDY | 3-1 |
| 3.1 TSS MONITORING DURING SPRING HIGH FLOW/ICE BREAKUP | 3-1 |
| 3.1.1 Collection Summary..... | 3-1 |
| 3.1.2 Results | 3-1 |
| 3.1.2.1 Stage Height and Flow Data | 3-1 |
| 3.1.2.2 Monitoring Results..... | 3-2 |
| 3.1.2.3 Comparison to Historic Data..... | 3-3 |
| SECTION 4 QUALITY ASSURANCE/QUALITY CONTROL..... | 4-1 |
| 4.1 INTRODUCTION | 4-1 |
| 4.2 QA/QC PROCEDURES..... | 4-1 |
| 4.3 RESULTS OF QA/QC ANALYSES..... | 4-3 |
| 4.3.1 Water Column | 4-3 |
| 4.3.2 Resident Fish..... | 4-5 |
| 4.4 SUMMARY..... | 4-6 |
| SECTION 5 REFERENCES | 5-1 |

Tables

- Table 1-1. 2005 data collection summary.
- Table 2-1. Summary of 2005 SRS water column monitoring activities.
- Table 2-2. 2005 SRS water column monitoring activities - PCB results.
- Table 2-3. 2005 SRS water column monitoring activities – total suspended solids results.
- Table 2-4. Number of samples collected/number of samples targeted.
- Table 2-5. Adult resident fish collection field and laboratory data - smallmouth bass and brown bullhead.
- Table 2-6. Resident fish collection field and laboratory data - young-of-year spottail shiner.
- Table 3-1. TSS data collected during 2005 high flow sampling at the Main Street and Alcoa Bridges.
- Table 4-1. Individual samples not meeting QA/QC guidelines.

Figures

- Figure 1-1. Grasse River study area – location map.
- Figure 2-1. 2005 SRS program – water column monitoring locations.
- Figure 2-2. Grasse River flow and precipitation information from 2005.
- Figure 2-3. Method comparison for measuring/estimating Grasse River flows in 2005.
- Figure 2-4. Water temperature and specific conductivity measurements during water column routine monitoring in 2005.
- Figure 2-5. Spatial distribution of TSS concentrations measured during the 2005 SRS Program.
- Figure 2-6. Monthly average PCB concentrations at water column sampling locations in 2005.
- Figure 2-7. Monthly average PCB mass fluxes at water column sampling locations in 2005.

- Figure 2-8. Spatial distribution of total PCBs in water samples collected during the 2005 SRS program.
- Figure 2-9. Average homolog distributions in water samples collected in 2005.
- Figure 2-10. Seasonal average water column PCB concentrations measured during non-stratified periods.
- Figure 2-11. Seasonal average water column PCB mass fluxes measured during non-stratified periods.
- Figure 2-12. Adult smallmouth bass sample collection locations.
- Figure 2-13. Adult brown bullhead sample collection locations.
- Figure 2-14. Young-of-year spottail shiner sample collection locations.
- Figure 2-15. Average Aroclor-based PCB concentrations in fish collected in Fall 2005.
- Figure 2-16. Average Aroclor-based PCB levels in smallmouth bass (1991-2005).
- Figure 2-17. Average Aroclor-based PCB levels in smallmouth bass from the Power Canal.
- Figure 2-18. Average Aroclor-based PCB levels in brown bullhead (1991-2005).
- Figure 2-19. Average Aroclor-based PCB levels in young-of-year spottail shiner (1998-2005).
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- Figure 3-1. Water column sampling locations in March/April 2005 (TSS Sampling).
- Figure 3-2. Stage height, flow, and total suspended solids from March 31 – April 4, 2005.
- Figure 3-3. Water column TSS concentrations versus stage height (March 31 – April 3, 2005).
- Figure 3-4. Solids concentrations measured at the Main Street Bridge/WC001 as a function of river flow.

Appendices

- Appendix A. Grasse River Geographic Information Systems (GIS) Project Database.
- Appendix B. Technical Memorandum - 2005/2006 River Ice Monitoring Documentation Summary.

SECTION 1 INTRODUCTION

This document summarizes a portion of the field sampling activities and data collected by Alcoa Inc. (Alcoa) in the Grasse River Study Area (Study Area) located in Massena, New York (NY) during the 2005 field sampling season. The information described in this report includes the results of the annual Supplemental Remedial Studies (SRS) Program monitoring and the results of the total suspended solids (TSS) monitoring during spring high flow/ice breakup conducted in 2005 as part of the Focused Studies. In addition, Appendix B of the report provides the results of the 2005/2006 ice monitoring activities. The results of the monitoring conducted prior to, during, and after the implementation of the 2005 Remedial Options Pilot Study (ROPS) as described in the ROPS Work Plan (Alcoa, February 2005) are presented in the draft ROPS Documentation Report (Alcoa, May 2006). The results of the annual river ice monitoring program for winter 2004/2005 as described in the 2004/2005 Grasse River Ice Monitoring Work Plan (Alcoa, January 2005) are presented in the Technical Memorandum - Grasse River Project 2004/2005 River Ice Monitoring Documentation Summary (Alcoa, April 2006).

The Study Area is located along the northern boundary of NY State in the town and village of Massena, and encompasses approximately 8.5 miles of the Grasse River from Massena (just downstream of the Route 37 Bridge) to the confluence of the St. Lawrence River (**Figure 1-1**). The Study Area also includes Robinson Creek (which discharges to the St. Lawrence River) and the Massena Power Canal (which extends from the Massena Intake Dam located on the St. Lawrence River to the former Massena Power Dam). Monitoring and sampling activities were performed throughout the Study Area (except Robinson Creek).

The 2005 sampling program included the following activities:

2005 SRS Program

- routine water column monitoring; and
- resident fish trend monitoring.

2005 Focused Study

- TSS monitoring during spring high flow/ice breakup.

These field sampling activities were performed in accordance with the 2005 Monitoring Work Plan (Alcoa, March 2005). **Table 1-1** provides a summary of each sampling event conducted and the total number of measurements made/samples collected as a result of each activity.

It should be noted that the ROPS included intrusive river activities such as dredging and capping between April and December 2005. Specifically, the ROPS consisted of four components: 1) removal of debris and sediment from an 8-acre portion of the main channel, followed by capping; 2) removal of debris and sediment from a 0.5-acre area along the northern shoreline, followed by capping; 3) placement of a thin-layer cap over sediments in an approximate 0.5-acre area along the southern shoreline; and 4) construction of an armored cap in a 1-acre portion of the main channel. The approximate location and areal extent of the ROPS work areas are shown in **Figures 1-1** and **2-1**. The effects of the ROPS activities are evident in the water column and resident fish data collected in 2005. These effects are discussed in Section 2 of this report, particularly in the comparisons to historical data.

Sample collection summaries and results for the SRS Program and Focused Study are provided in Sections 2 and 3, respectively. Section 4 presents a review of the quality assurance/quality control (QA/QC) samples collected and analyzed as part of the above studies. In addition to the main body of this report, two appendices are included. An electronic database containing field-derived data from the 2005 sampling programs discussed in this report, as well as data collected historically from the river, is included as **Appendix A**. **Appendix B** contains a memorandum discussing the river ice monitoring activities conducted over winter 2005/2006, as outlined in the 2005/2006 Grasse River Ice Monitoring Work Plan (Alcoa, December 2005).

GRASSE RIVER STUDY AREA
MASSENA, NEW YORK

Table 1-1
2005 Data Collection Summary

| Medium | Number of Sampling Events | Number of Field Samples ¹ | Laboratory Analyses |
|----------------------|------------------------------|---|------------------------|
| Routine Water Column | 15 | 195 | PCB, TSS ² |
| Resident Fish | 1 | 144 | PCB, Percent Lipid |
| TSS Monitoring | 12 | 24 | TSS |

Notes:

1. Counts do not include QA/QC samples. Counts do not include multiple samples to be analyzed for various parameters from the same location/sample submitted to the same laboratory.
2. One sampling bottle broke during shipment to the laboratory. Only 194 samples were analyzed for TSS.
3. PCB - polychlorinated biphenyls, TSS - total suspended solids
4. Two additional sampling programs were conducted in 2005 and are summarized elsewhere:
 - river ice monitoring over winter 2004/2005 (Alcoa, January 2005; Alcoa, April 2006)
 - pre, during, and post monitoring associated with the 2005 Remedial Options Pilot Study (Alcoa, February 2005; Alcoa, May 2006)

Section 2

SECTION 2 2005 SRS PROGRAM

2.1 ROUTINE WATER COLUMN MONITORING

2.1.1 Collection Summary

Routine water column monitoring was performed biweekly between April and October 2005 for a total of 15 sampling rounds. Water column samples were routinely collected from seven locations (see **Figure 2-1**) – Main Street Bridge in Massena (WCMSB); T11 (WCT11); water column transect (WC) 007; Route 131 Bridge (WC131); WC011; WC012; and WC013. Water column samples were collected to continue the ongoing monitoring of polychlorinated biphenyl (PCB) concentrations in the water column and to document variations associated with location, season, flow, temperature, biological activity, and other variables. Samples were collected from the above seven locations on the dates provided below.

- Round 1: April 7, 2005;
- Round 1: April 7, 2005;
- Round 3: May 2 and 3, 2005;
- Round 4: May 17, 2005;
- Round 5: May 31 and June 1, 2005;
- Round 6: June 16 and 17, 2005;
- Round 7: June 29 and 30, 2005;
- Round 8: July 13 and 14, 2005;
- Round 9: July 27, 2005;
- Round 10: August 9, 2005;
- Round 11: August 22, 2005;
- Round 12: September 7, 2005;
- Round 13: September 21 and 22, 2005;

- Round 14: October 4, 2005; and
- Round 15: October 18, 2005.

During each event, samples were collected mid-channel at each location using a stainless steel Kemmerer water sampler as described in the 2005 Monitoring Work Plan (Alcoa, March 2005). At WCT11, WC007, WC131, WC011, WC012, and WC013 one sample was collected from each location at 0.2 and 0.8 times the total water column depth (i.e., total of two samples per location). Due to shallow water depth at WCMSB, one sample was collected at 0.5 times the total water column depth. Sampling was performed via boat at all locations except WCMSB, where samples were collected from the Main Street Bridge (or just downstream of the bridge depending on flow conditions) as water depths and access limitations precluded collection from a boat.

Prior to the collection of samples at each location, the total water column depth was recorded and specific conductivity and water temperature measurements were obtained every two feet in the water column at mid-channel to check for the presence of stratification. Field water quality measurements of specific conductivity, water temperature, pH, turbidity, and dissolved oxygen (DO) were also collected at 0.2 and 0.8 times the total water column depth at mid-channel at WCT11, WC007, WC131, WC011, WC012, and WC013. Water quality measurements associated with the sample collected at WCMSB were collected at WC001 during velocity measurements or just downstream of the bridge. Additional information pertinent to field activities for each sampling round, including any necessary variations to the protocol described in the 2005 Monitoring Work Plan (Alcoa, March 2005), are provided on **Table 2-1**.

A total of 195 water samples (not including QA/QC samples) were packaged and shipped to Northeast Analytical, Inc. (NEA) in Schenectady, NY consistent with the methodologies outlined in the 2005 Monitoring Work Plan (Alcoa, March 2005). Water column samples were analyzed for PCB congeners and TSS. QA/QC sampling included the collection of an equipment rinse blank before and after each sampling round, and one duplicate and one matrix spike/matrix spike duplicate (MS/MSD) each round. The equipment rinse blanks and MS/MSD samples were

analyzed for PCB congeners, and the duplicate samples were analyzed for PCB congeners and TSS. Details on the results of the QA/QC sampling are presented in Section 4.

Throughout the spring (i.e., Rounds 2 through 7), velocity profile measurements to estimate river flow were obtained concurrently with the collection of water quality measurements at WC001 (note that a velocity profile could not be collected during Round 1 due to unsafe, high river flow conditions). Velocity profiling was conducted as detailed in the 2005 Monitoring Work Plan (Alcoa, March 2005); any variations to the described protocol were noted and are provided in **Table 2-1**. As described in the 2005 Monitoring Work Plan (Alcoa, March 2005), velocity profiling was discontinued following the higher spring flows as adequate data had been collected to assess the comparability between the velocity profile and the United States Geological Survey (USGS) gage located on the Grasse River in Chase Mills, NY. The velocity profiles from WC001 in 2004 and 2005 during low and high flows compared favorably with measurements from the USGS gage, and had an average relative percent difference (RPD) of about 10%. Since these comparisons provided a level of confidence that the gage was giving realistic estimates of flows near Massena, velocity profiling at WC001 was discontinued. Tapedown measurements (i.e., distance from bridge to water surface), which were typically obtained at the Main Street Bridge, were not possible due to bridge construction that resulted in the destruction of the reference point previously used to obtain these measurements.

2.1.2 Results

Routine water column monitoring data from 2005 can be found on the attached CD-ROM (**Appendix A**) in the data tables entitled climate, riverflow_ChaseMills, riverflow_hist, riverflow_tapedown, water_field, and water_iupac. PCB and TSS results for 2005 also are summarized in **Tables 2-2** and **2-3**.

2.1.2.1 River Flow and Precipitation

Daily flow and precipitation data measured in 2005 are shown in **Figure 2-2**. The annual average flow estimated from 15-minute provisional flow records from the USGS gage on the

Grasse River at Chase Mills was approximately 1,444 cubic feet per second (cfs), higher than the long-term average Grasse River flow of 1,100 cfs (Alcoa, April 2001). Instantaneous flows based on velocity measurements at WC001 during the routine water column monitoring rounds were comparable to the daily average flows estimated from flow records at Chase Mills; the average RPD between the flow measurements at Chase Mills and flows based on velocity measurements at WC001 in 2005 was 12%, similar to the 10% RPD observed in data from 2004 and 2005 (**Figure 2-3**). At the Chase Mills gage, the spring-time peak daily average flow of 8,144 cfs was observed in early April, and was within the range of typical spring flows for the lower Grasse River. Flows decreased during the summer months (i.e., June through August), with an average flow of 457 cfs. River flows in September were higher than usual due to remnants of Hurricane Katrina, which caused river flows to increase to a maximum daily average reading of 8,187 cfs.

Precipitation measured near Outfall 007 during 2005 totaled about 34 inches, higher than the long-term average annual total by about 3 inches. The maximum daily precipitation measurement of 3.6 inches occurred on August 31, 2005.

2.1.2.2 Water Quality

Stratification occurs in the lower Grasse River when colder water with higher specific conductivity (relative to the Grasse River water) from the St. Lawrence River enters into and moves upstream along the bottom of the lower Grasse River. Therefore, differences in water temperature and specific conductivity were examined to determine the presence of stratification in the lower Grasse River (**Figure 2-4**). Water temperature data showed the river was stratified at WC013 from mid-May to mid-July and as far upstream as WCT11 in June; the pattern was similar in the specific conductivity data, although measurements of specific conductivity also indicated stratification at WC131 from mid-June to July and at WC013 from mid-July to August. These seasonal and spatial patterns in stratification are consistent with observations made during previous years (Alcoa, April 2001).

TSS levels measured throughout the river were generally low. Prior to June, no consistent spatial pattern was observed; depth-averaged TSS levels ranged from 0.8 to 8.9 milligrams per liter (mg/L). The majority of ROPS dredging occurred between sediment probing Transect T7 and T9.5 (approximately river mile 6.2 to river mile 5.9; **Figure 2-1**) from June to October and, as expected, TSS levels measured at the station immediately downstream of the ROPS area (WCT11) were elevated and declined with distance downstream (**Figure 2-5**). The average TSS concentrations were 5.0, 4.5, and 4.1 mg/L at WCT11, WC007, and WC131, respectively. Average TSS levels were generally lower downstream of WC131 (3.6 mg/L at WC011, 3.1 mg/L at WC012, and 3.3 mg/L at WC013). The highest TSS concentration measured in association with the SRS monitoring during the ROPS was 10.8 mg/L at WC007 on July 27th (at an estimated flow of about 336 cfs) at 0.2 times the total water column depth. An average TSS concentration of 3.1 mg/L was observed at WC001/WCMSB.

2.1.2.3 PCBs

The impact of the ROPS dredging in 2005 accentuated the typical seasonal pattern in PCB levels in the water column observed in the lower Grasse River in past years. Historical PCB levels generally are low in the spring, increase in the summer, and decline in the fall. PCB levels in water column samples from 2005 follow this pattern too; however, largely due to the ROPS dredging activities that occurred from June to October approximately 700 feet (ft.) upstream of WCT11, concentrations were much higher than usual at all downstream locations (**Figure 2-6**). Average levels in samples collected at 0.2 times the total water depth¹ were at or below 53 nanograms per liter (ng/L) during April and May, generally increased from June through August (up to 1,600² ng/L), and then declined to 522 ng/L or less in September and October.

PCB mass flux (i.e., the product of PCB concentration and river flow) was calculated to account for seasonal differences in river flow. In 2005, the average PCB mass fluxes were about

¹ Samples from 0.8 times the total water depth were not used in the evaluation of seasonal trends since stratification was present during many sampling rounds.

² PCB concentrations at downstream ROPS monitoring stations never exceeded the corrective action level limit of 2 micrograms per liter (µg/L) (Alcoa, May 2006).

40 grams/day (g/day) in both April and May (**Figure 2-7**). After the initiation of ROPS dredging in June, the average monthly PCB mass flux peaked (up to 934 g/day) at WCT11, WC007, and WC131 and then generally declined over time to less than 252 g/day in September; in October, the average monthly PCB mass fluxes increased up to 566 g/day, likely due to dredging activities that were occurring during the first part of the month. At downstream stations WC011 and WC012, the highest average fluxes (up to 894 g/day) occurred in July and then declined in the following months to less than 151 g/day in October. At WC013, PCB mass fluxes also peaked at 1,426 g/day, on average, in July and declined in subsequent months.

The spatial patterns observed in water column PCB levels in the lower Grasse River differed in 2005 compared to historic data due to the impact of the ROPS (**Figure 2-8**). Historically, PCB levels generally increased from upstream to downstream during non-stratified periods and were lowest at WC001/WCMSB, peaked at WC007, WC131, WC011, or WC012 (depending on the extent of stratification), and declined at WC013 due to the dilution of Grasse River water with St. Lawrence River water during times when the river was stratified. With the exception of an anomalous measurement of 70 ng/L during Round 1 at WCT11, these typical patterns can be observed in 2005 during April and May (prior to the ROPS activities). From June through October, PCB releases from the ROPS dredging influenced the spatial pattern. The highest PCB concentrations were typically measured at WCT11 (700 ft. downstream of the dredging area), and declined with distance downstream. This pattern was not observed during some rounds, likely a function of the non-continuous operation of the dredge and/or differences in PCB concentrations of sediments being dredged (Alcoa, May 2006). For example, during the July 13-14, 2005 monitoring round, the historical pattern of increasing PCB concentrations from upstream to downstream coincides with no dredging activities being conducted that day due to severe weather. During stratified periods, PCB levels measured in samples collected from the Grasse River water (i.e., 0.2 times the total water column depth) were generally higher than those measured in samples from St. Lawrence River water (i.e., 0.8 times the total water column depth) because of the PCB releases due to the ROPS (**Figure 2-8**).

Average PCB homolog distributions exhibit seasonal patterns (**Figure 2-9**). Di- and tri-chlorinated biphenyls (CBs) dominated the average PCB homolog distributions, each comprising

approximately 40% of the total PCBs. In the spring, the percentages of di-CBs were higher than tri-CBs (43% versus 30%, on average); during the summer, di-CBs were lower than tri-CBs (35% versus 47%, on average); and during the fall, the percentages of di- and tri-CBs were similar (averaging 40 to 42%). This pattern was more evident at the upstream stations than at the downstream stations.

Average PCB homolog distributions exhibit spatial patterns (**Figure 2-9**). The difference between weight percentages of di- and tri-CBs decreased from upstream to downstream during the spring and summer and increased slightly from upstream to downstream in the fall. At WCT11, samples were composed of 34 to 37% di-CBs in spring and summer; tri-CBs consisted of 20 to 47% of total PCBs during these two seasons. At WC013, di-CBs were 38 to 44% of total PCBs, while tri-CBs comprised 32 to 45% during spring and summer. In the fall, the percentages of di- and tri-CBs at WCT11 were similar at 41%; at WC013, di-CBs were lower than tri-CBs (37 vs 45%, respectively). During all three seasons, mono-CBs generally increased or stayed the same between WCT11 and WC011 and then declined to WC013.

2.1.2.4 Comparison to Historic Data

The ROPS in-river activities in 2005 contributed to much higher than usual PCB levels in the water column compared to historic levels (**Figure 2-10**). Excluding the data obtained during the 2005 monitoring events, PCB levels have exhibited an overall decline over the period of record (i.e., 1995 to 2004). These declines are partially explained by seasonal and year-to-year variations in river flow. However, the patterns also are evident in PCB mass flux, indicating that PCB sources to the river vary seasonally and have declined over the period of record (**Figure 2-11**).

2.2 RESIDENT FISH TREND MONITORING SURVEY

2.2.1 Collection Summary

The fall resident fish trend monitoring program was performed between August 29 and September 21, 2005 in the Study Area to continue observation of annual trends in fish PCB concentrations, as well as collect and analyze young-of-year (YOY) spottail shiner samples to serve as an indicator of short-term PCB exposure. Sample collection activities were performed as detailed in the 2005 Monitoring Work Plan (Alcoa, March 2005) and under the 2005 Fish and Wildlife License (#341). Sampling efforts were conducted in the Massena Power Canal and four stretches of the lower Grasse River: Background; Upper; Middle; and Lower (Figures 2-12 through 2-14). The resident fish species targeted during this program included adult (≥ 25 centimeters [cm]) smallmouth bass (*Micropterus dolomieu*), adult (≥ 25 cm) brown bullhead (*Ameiurus nebulosus*), and YOY (< 6.5 cm) spottail shiner (*Notropis hudsonius*). Collection of adult spottail shiner was discontinued in 2005, as described in the 2005 Monitoring Work Plan (Alcoa, March 2005), due to repeated inadequate sample numbers collected for chemical analysis and lack of historic data for trend analysis. Resident fish were collected using a boat-mounted electrofishing unit; gill netting techniques were used to supplement boat electrofishing in the Power Canal only. A summary of the number of fish targeted and collected within each reach is provided in Table 2-4.

Seventeen adult smallmouth bass were targeted and collected from the Massena Power Canal, and 17 adult smallmouth bass and 18 adult brown bullhead each were targeted and collected from the Upper, Middle, and Lower Stretches of the river. Five adult smallmouth bass and five adult brown bullhead were targeted and collected from the Background Stretch (three brown bullhead were slightly smaller than 25 cm [20.9 – 24.8 cm] due to a paucity of larger fish). Approximate adult smallmouth bass and brown bullhead sample collection locations are presented on Figures 2-12 and 2-13, respectively.

YOY spottail shiners were targeted for collection from four locations within the Study Area: near Outfall 001; near the Unnamed Tributary; at the mouth of the river; and within the

Background Stretch. Three YOY whole-body composite samples (containing between 16 and 40 individual spottail shiners) were targeted and collected at each location. Approximate spottail shiner collection locations are presented on **Figure 2-14**.

A total of 144 fish samples (not including QA/QC samples) were packaged and shipped to NEA for analysis of PCB Aroclors and lipid content in accordance with the 2005 Monitoring Work Plan (Alcoa, March 2005). These included 73 smallmouth bass fillets (skin-on, scales-off), 59 brown bullhead fillets (skin-off), and 12 YOY spottail shiner whole-body composite samples. QA/QC samples consisted of one MS/MSD pair per 20 samples collected; these samples were prepared by the laboratory from submitted fish samples.

2.2.2 Results

2.2.2.1 PCB Results

Resident fish data from 2005 can be found on the attached CD-ROM (**Appendix A**) in the data table entitled *resfish_aro*. PCB results also are listed in **Tables 2-5** and **2-6** and are discussed below by species. Discussion of the 2005 resident fish data can also be found in the draft ROPS Documentation Report (Alcoa, May 2006).

Smallmouth Bass

Average PCB concentrations for smallmouth bass are shown on the two left panels in **Figure 2-15**. Lipid-normalized PCB levels were below detection for two of the five samples from the Background Stretch, highest in the Upper Stretch, and declined with distance downstream. Average lipid-normalized PCB concentrations were 604, 566, and 488 parts per million (ppm) in the Upper, Middle, and Lower Stretches, respectively. The differences among stretches, however, are not statistically significant since error bars representing the 95th percentile confidence limit overlap. The average lipid-normalized PCB concentration in

smallmouth bass from the Power Canal was 182 ppm lipid³, about 2.7 to 3.3 times lower than those from the Grasse River proper

On a wet-weight basis, average PCB concentrations in smallmouth bass were highest in the Middle and Lower Stretches (5.2 and 4.9 ppm) and slightly lower in the Upper Stretch (4.0 ppm). Overlapping error bars representing the 95th percentile confidence limits indicate that these differences are not statistically significant. PCB levels in two of the five smallmouth bass samples were below detection (about 0.05 ppm wet weight) in the Background Stretch and in two of the 17 samples from the Power Canal, with average concentrations in each stretch of 0.1 and 0.6 ppm, respectively. PCB levels in the Power Canal ranged from below detection to 1.6 ppm wet weight.

Brown Bullhead

Average PCB concentrations for brown bullhead are shown on the middle panels in **Figure 2-15**. Lipid-normalized PCB levels were lowest in the Background Stretch⁴, highest in the Upper Stretch, and declined with distance downstream. The average lipid-normalized PCB levels were 741, 516, and 381 ppm in brown bullhead from the Upper, Middle, and Lower Stretches, respectively.

On a wet-weight basis, average wet-weight PCB concentrations in brown bullhead were highest in the Upper Stretch (15.1 ppm) and declined with distance downstream (10.5 and 8.6 ppm in the Middle and Lower Stretches, respectively). PCB levels were the lowest in the Background Stretch, with an average concentration of 0.1 ppm. The PCB concentration in one of the five samples from the Background Stretch was below detection (about 0.2 ppm wet weight).

³ One smallmouth bass sample from the Power Canal was excluded from the lipid-normalized average due to extremely low lipid content of the sample (0.05%).

⁴ One brown bullhead sample from the Background Stretch was excluded from the lipid-normalized average due to extremely low lipid content of the sample (0.05%).

YOY Spottail Shiner

Average PCB concentrations for YOY spottail shiner are shown on the right panels in **Figure 2-15**. PCB levels were highest near the Unnamed Tributary (downstream of the ROPS activities) and were lower at the Mouth and Outfall 001 (upstream of the ROPS activities). The average lipid-normalized PCB concentrations were 194, 422, and 250 ppm near Outfall 001, near the Unnamed Tributary, and at the River Mouth, respectively. PCB levels were lowest in the Background Stretch, with an average of 3 ppm.

On a wet-weight basis, average PCB concentrations in YOY spottail shiner were highest near the Unnamed Tributary (19.5 ppm) and lower near Outfall 001 and at the River Mouth (7.0 and 9.1 ppm, respectively). Concentrations were lowest in the Background Stretch, with an average of 0.1 ppm wet weight. No PCB concentrations in the YOY composites were below detection limits.

2.2.2.2 Comparison to Historic Data

PCB levels in resident fish collected in 2005 are higher than in recent years for all species of fish targeted. This increase in fish tissue PCBs appears to be related to the PCB releases that occurred during the ROPS, which took place summer through fall 2005. Average lipid-normalized PCBs are highest immediately downstream of the ROPS area (i.e., Upper Stretch) and decline with distance downstream, exhibiting a distinct spatial trend consistent with increased exposure to PCBs that were released during the ROPS sediment and debris removal activities.

Historic data for smallmouth bass and brown bullhead are presented in **Figures 2-16 to 2-18**. Average lipid-normalized PCB levels in smallmouth bass and brown bullhead are 2 to 4 times higher than those measured in 2004, and consistently higher than those measured over the past several years. This is evident for the Upper, Middle, and Lower Stretches, where similar patterns were also observed in PCB concentrations on a wet-weight basis. The average lipid-based PCB concentration in smallmouth bass collected in 2005 from the Power Canal was about

3 times higher than in 2004; however, this increase is due to the lower (almost 3-fold) lipid content of the fish in 2005 compared to those caught in 2004. PCB levels in smallmouth bass from the Power Canal in 2005 were similar to those in 2004 when compared on a wet-weight basis.

Historic data for YOY spottail shiner are presented in **Figure 2-19**. The YOY spottail shiner samples from 2005 contain the highest PCB level measured in YOY spottail shiner on record⁵. Large increases in average lipid-normalized PCBs are observed in YOY spottail shiner near Outfall 001 and the Unnamed Tributary, where 2005 levels are 5 to 6 times higher than those measured in 2003 and 2004. The greatest increase in PCB concentration for YOY spottail shiner is at the Mouth. At this location, the average lipid-normalized PCB concentration in 2005 is 25 times higher than 2004. The greater increase in PCB levels of the YOY spottail shiner (relative to adult smallmouth bass and brown bullhead) is not unexpected, as small fish respond quicker to changes in PCB exposure than large fish.

⁵ Prior to 2001, YOY spottail shiners were not specifically targeted for collection; collections consisted of both adult and YOY spottail shiners. **Figure 2-19** includes composite samples of fish with a maximum length of 65 mm, the current monitoring program's criterion for distinguishing between YOY and adult spottail shiners. Also, in 2001, two groups of spottail shiners were encountered in the field; one group consisted of spottail shiners spawned in the spring and the other contained spottail shiners spawned in the late summer/fall. For proper comparison, only the results for the YOY spottail shiners spawned in the fall were considered.

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-1
Summary of 2005 SRS Water Column Monitoring Activities**

| Round # | Sample Date | Additional Sampling Information |
|---------|-------------------|--|
| 1 | 4/7/05 | No velocity profile recorded due to high flow conditions at WC001. The water quality parameters and samples at WCMSB were taken approximately 100 feet downstream of bridge and approximately 10 feet from shore due to high flow conditions at the bridge. |
| 2 | 4/19/05 | The velocity measurement at Station 2+20 was taken at a depth of 0.5 times the total water column depth (0.9 feet) due to shallow water depth. Field parameters associated with the sample obtained at WCMSB were collected at WC001 concurrently with the velocity profile. |
| 3 | 5/2/05 - 5/3/05 | The water sample at WCMSB was collected on 5/2/05; samples from all other locations were collected on 5/3/05. Field parameters associated with the sample obtained at WCMSB were collected at WC001 concurrently with the velocity profile. |
| 4 | 5/17/05 | The velocity measurement at Station 2+20 was taken at a depth of 0.5 times the total water column depth (1.35 feet) due to shallow water depth. Field parameters associated with the sample obtained at WCMSB were collected at WC001 concurrently with the velocity profile. |
| 5 | 5/31/05 - 6/1/05 | The water sample at WCMSB was collected on 5/31/05; samples from all other locations were collected on 6/1/05. Field parameters associated with the sample obtained at WCMSB were collected at WC001 concurrently with the velocity profile. |
| 6 | 6/16/05 - 6/17/05 | Field parameters associated with the sample obtained at WCMSB were collected at WC001 concurrently with the velocity profile. |
| 7 | 6/29/05 - 6/30/05 | All water samples were collected on 6/29/05. The velocity profile and field parameters associated with the sample obtained at WCMSB were recorded at WC001 on 6/30/05. |
| 8 | 7/13/05 - 7/14/05 | The velocity profile was discontinued from this point forward. The water sample at WCMSB was collected on 7/13/05; samples from all other locations were collected on 7/14/05. Field parameters associated with the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |
| 9 | 7/27/05 | Field parameters associated the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |
| 10 | 8/9/05 | Field parameters associated the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |
| 11 | 8/22/05 | Field parameters associated the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |
| 12 | 9/7/05 | Field parameters associated the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |
| 13 | 9/21/05 - 9/22/05 | The following PCB congener samples were broken upon arrival at NEA: WCMSB-13(0.5), WC131-13(0.8) and WC-05-13 (duplicate). NEA analyzed the TSS samples for PCB congeners, and TSS samples from these locations were re-collected in the field on 9/22/05 and submitted for analysis. Field parameters associated the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |
| 14 | 10/4/05 | Field parameters associated the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |
| 15 | 10/18/05 | Field parameters associated the sample obtained at WCMSB were collected just downstream of Main Street Bridge, from the edge of shore. |

Note:

1. The measuring point used to obtain the tapedown measurement was destroyed in April/May 2004 during construction at the Main Street Bridge. This measurement was consequently unavailable throughout the entire sampling season.

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-2
2005 SRS Water Column Monitoring Activities
PCB Results**

| Round | Date | Flow ⁴ [cfs] | Mean Temperature ⁵ [deg C] | Mean Conductivity ⁵ [uS/cm] | Fraction of Total Water Depth ⁶ | Total PCBs [ng/L] ⁷ | | | | | | |
|-------|---------------|----------------------------|---|--|--|--------------------------------|--------------------------------------|------------------------|-----------------|------------------------|----------------|-------------------------|
| | | | | | | WCMSB | WCT11 | WC007 | WC131 | WC011 | WC012 | WC013 |
| 1 | April 7 | 3,205 | 5.8 | 107 | 0.2 0.8 | 5.6 | 5.4 69.8 | 4.6 (3.3) 4.6 | 6.6 8.9 | 10.3 18.2 | 34.5 6.7 | 3.3 3.1 |
| 2 | April 19 | 715 | 12.3 | 101 | 0.2 0.8 | 0.3 | 0.0 ⁸ 0.4 | 1.1 (0.9) 1.6 | 0.8 7.7 | 8.2 6.0 | 4.4 4.1 | 2.4 0.0 ⁸ |
| 3 | May 2-3 | 1,655 | 10.0 | 111 | 0.2 0.8 | 0.8 | 0.0 ⁸ 0.0 ⁸ | 0.0 (1.7) 1.9 | 5.0 6.7 | 6.0 6.4 | 19.1 14.4 | 25.2 20.3 |
| 4 | May 17 | 1,027 | 14.9 | 124 | 0.2 0.8 | 0.0 ⁸ | 36.0 (1.1) 13.1 | 19.6 10.5 | 23.1 15.8 | 46.7 27.0 | 52.6 51.6 | 51.6 7.8 |
| 5 | May 31-June 1 | 305 | 19.5 | 136 | 0.2 0.8 | 0.2 | 16.3 (11.3) 21.9 | 5.5 15.8 | 13.9 69.9 | 11.8 32.5 | 19.6 30.7 | 19.0 9.5 |
| 6 | June 16-17 | 527 | 23.5 | 143 | 0.2 0.8 | 5.8 | 1666.7 1321.8 | 1241.9 357.2 | 1286.0 509.0 | 542.0 363.1 | 317.1 189.7 | 289.6 32.4 |
| 7 | June 29-30 | 191 | 25.7 | 151 | 0.2 0.8 | 0.0 ⁸ | 506.2 438.1 | 510.8 (528.5) 265.6 | 403.2 268.9 | 323.4 161.2 | 209.9 79.2 | 144.7 19.1 |
| 8 | July 13-14 | 879 | 25.3 | 99 | 0.2 0.8 | 0.9 | 161.4 (171.7) 97.4 | 93.4 78.8 | 196.5 212.1 | 349.3 342.7 | 590.1 579.8 | 1058.0 145.0 |
| 9 | July 27 | 336 | 25.7 | 182 | 0.2 0.8 | 0.3 | 92.9 1488.1 | 1046.4 987.0 | 702.2 679.1 | 683.4 (699.5) 803.0 | 363.5 346.1 | 220.8 118.0 |
| 10 | August 9 | 157 | 25.9 | 171 | 0.2 0.8 | 30.9 | 388.7 (457.2) 396.1 | 347.4 294.0 | 280.0 353.0 | 329.6 326.0 | 260.3 117.2 | 139.0 113.2 |
| 11 | August 22 | 198 | 23.1 | 155 | 0.2 0.8 | 0.7 | 767.4 (848.4) 701.9 | 611.4 636.3 | 788.3 695.2 | 461.1 515.9 | 311.7 275.2 | 101.2 76.2 |
| 12 | September 7 | 483 | 21.3 | 97 | 0.2 0.8 | 0.4 | 97.7 (155.2) 87.8 | 80.4 106.0 | 79.7 91.8 | 97.4 112.5 | 103.6 105.1 | 101.9 106.9 |
| 13 | Sept. 21-22 | 2,039 | 18.4 | 78 | 0.2 0.8 | 0.0 (0.0) ⁸ | 59.0 21.1 | 16.0 14.1 | 18.5 3.7 | 20.4 17.6 | 27.2 23.5 | 48.4 40.4 |
| 14 | October 4 | 822 | 16.8 | 115 | 0.2 0.8 | 2.5 | 457.9 (585.7) 435.7 | 188.8 173.4 | 172.8 206.4 | 81.4 80.4 | 67.4 63.8 | 50.8 46.9 |
| 15 | October 18 | 3,841 | 10.8 | 119 | 0.2 0.8 | 10.7 | 7.7 (9.7) 8.5 | 8.5 13.2 | 7.3 5.7 | 14.7 15.4 | 15.3 17.4 | 30.4 35.6 |

Notes:

1. Duplicate values in parentheses.
2. All samples unfiltered.
3. Units: cfs = cubic feet per second; deg C = degrees Celsius; uS/cm = micro-Siemens per centimeter; ng/L = nanogram per liter
4. For Rounds 2-7, flows was measured at WC001 on the same or previous day. For all other Rounds, daily average flows were calculated from records at the USGS gage at Chase Mills.
5. Mean excludes transects where stratification was observed.
6. Water samples at WCMSB collected at 0.5*total water depth.
7. Locations shown on Figure 2-1.
8. The concentrations of all PCB congeners were reported as non-detect (less than the per congener method detection limit (MDL) of 0.2 ng/L). The total PCB concentration reported by the laboratory is the sum of all congener concentrations above the MDL.

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-3
2005 SRS Water Column Monitoring Activities
Total Suspended Solids Results**

| Round | Date | Flow ⁵ [cfs] | Mean Temperature ⁶ [deg C] | Mean Conductivity ⁶ [uS/cm] | Fraction of Total Water Depth ⁷ | Total Suspended Solids [mg/L] ⁷ | | | | | | |
|-------|---------------|----------------------------|---|--|--|--|------------------|------------------|-------------|------------------|-------------|------------|
| | | | | | | WCMSB | WCT11 | WC007 | WC131 | WC011 | WC012 | WC013 |
| 1 | April 7 | 3,205 | 5.8 | 107 | 0.2 0.8 | 7.1 | 6.8 7.0 | 6.5 (5.4) 6.1 | 7.9 9.9 | 6.9 6.1 | 6.0 6.0 | 6.1 5.9 |
| 2 | April 19 | 715 | 12.3 | 101 | 0.2 0.8 | 1.8 | 2.8 2.1 | 2.9 (3.4) 2.4 | 2.9 3.7 | 3.7 4.3 | 2.9 2.7 | 3.0 2.4 |
| 3 | May 2-3 | 1,655 | 10.0 | 111 | 0.2 0.8 | 4.6 | 4.5 5.0 | 5.1 (5.3) 4.7 | 6.3 8.3 | 5.1 5.9 | 8.1 6.4 | 6.1 6.1 |
| 4 | May 17 | 1,027 | 14.9 | 124 | 0.2 0.8 | 0.8 | 2.0 (1.5) 3.2 | 2.9 3.1 | 3.7 3.5 | 3.5 4.2 | 5.0 7.7 | 5.4 1.6 |
| 5 | May 31-June 1 | 305 | 19.5 | 136 | 0.2 0.8 | 6.0 | 1.4 (1.2) 1.8 | -1.0 2.4 | 1.9 2.9 | 1.4 2.6 | 2.8 3.9 | 2.1 1.9 |
| 6 | June 16-17 | 527 | 23.5 | 143 | 0.2 0.8 | 3.6 | 8.4 (6.5) 9.1 | 5.3 5.5 | 6.0 5.5 | 4.8 5.8 | 4.1 4.8 | 2.0 3.8 |
| 7 | June 29-30 | 191 | 25.7 | 151 | 0.2 0.8 | 1.2 | 4.6 5.5 | 5.0 (4.4) 3.9 | 4.7 3.6 | 4.2 3.5 | 4.0 3.4 | 3.5 2.8 |
| 8 | July 13-14 | 879 | 25.3 | 99 | 0.2 0.8 | 4.8 | 3.9 (5.8) 3.9 | 3.6 3.6 | 2.9 3.5 | 3.1 4.2 | 2.3 3.4 | 3.7 3.3 |
| 9 | July 27 | 336 | 25.7 | 182 | 0.2 0.8 | 4.4 | N/A 10.4 | 10.8 9.0 | 8.8 4.6 | 3.0 (3.5) 4.0 | 4.3 3.2 | 2.2 3.4 |
| 10 | August 9 | 157 | 25.9 | 171 | 0.2 0.8 | 1.6 | 3.8 (1.6) 4.7 | 2.8 2.9 | 3.7 4.7 | 3.5 2.4 | 3.5 3.0 | 2.5 2.3 |
| 11 | August 22 | 198 | 23.1 | 155 | 0.2 0.8 | 1.2 | 5.5 (5.0) 5.2 | 3.5 3.0 | 3.9 4.2 | 3.6 3.2 | -2.0 3.1 | 3.0 3.4 |
| 12 | September 7 | 483 | 21.3 | 97 | 0.2 0.8 | -1.1 | 2.6 (2.0) 2.8 | 3.9 3.3 | 3.2 2.3 | 2.5 3.7 | 3.7 2.2 | 2.9 2.9 |
| 13 | Sept. 21-22 | 2,039 | 18.4 | 78 | 0.2 0.8 | 3.5 (5.3) | 5.0 5.6 | 3.7 3.9 | 3.6 2.3 | 3.6 3.3 | 1.9 3.1 | 3.8 3.8 |
| 14 | October 4 | 822 | 16.8 | 115 | 0.2 0.8 | -1.0 | 2.9 (2.0) 2.7 | 1.9 1.7 | 1.4 -1.0 | 1.6 2.1 | 1.6 2.6 | 1.4 1.8 |
| 15 | October 18 | 3,841 | 10.8 | 119 | 0.2 0.8 | 4.5 | 6.0 (4.5) 5.8 | 6.6 6.2 | 5.5 7.0 | 5.6 5.3 | 5.4 4.8 | 6.5 6.4 |

Notes:

1. Duplicate values in parentheses.
2. All samples unfiltered.
3. Results below detection listed at negative of the detection limit.
4. Units: cfs = cubic feet per second; deg C = degrees Celsius; uS/cm = micro-Siemens per centimeter; mg/L = milligrams per liter
5. For Rounds 2-7, flows was measured at WC001 on the same or previous day. For all other Rounds, daily average flows were calculated from records at the USGS gage at Chase Mills.
6. Mean excludes transects where stratification was observed.
7. Water samples at WCMSB collected at 0.5*total water depth.
8. N/A = 'Not Available'; Sample was collected but container arrived at the lab broken.
9. Locations shown on Figure 2-1.

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-4
2005 Resident Fish Trend Monitoring Study
Number of Samples Collected/Number of Samples Targeted**

| Resident Fish Species | Grasse River Stretch | | | | |
|-----------------------|--|---------|---------|---------|--------------|
| | Number of Samples Collected/Number of Samples Targeted | | | | |
| | Background | Upper | Middle | Lower | Power Canal |
| Adult Smallmouth Bass | 5 / 5 | 17 / 17 | 17 / 17 | 17 / 17 | 17 / 17 |
| Adult Brown Bullhead | 5 / 5 | 18 / 18 | 18 / 18 | 18 / 18 | not targeted |

| Resident Fish Species | Grasse River Location | | | |
|-------------------------------|--|------------------|------------------------|----------------|
| | Number of Samples Collected/Number of Samples Targeted | | | |
| | Background | Near Outfall 001 | Near Unnamed Tributary | Mouth of River |
| Young-of-Year Spottail Shiner | 3 / 3 | 3 / 3 | 3 / 3 | 3 / 3 |

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-5
2005 Resident Fish Trend Monitoring Study
Adult Resident Fish Collection Field and Laboratory Data - Smallmouth Bass and Brown Bullhead**

| Sample Area | Species | Sample ID | Date Collected | Length (cm) | Weight (g) | Lipid (%) | PCB (ppm wet) | PCB (ppm lipid) |
|--------------------|-----------------|------------|----------------|-------------|------------|-----------|---------------|-----------------|
| Background Stretch | Smallmouth bass | FS1-147-SB | 9/1 | 34.1 | 561 | 1.84 | 0.11 | 6 |
| | | FS1-148-SB | 9/1 | 27.2 | 266 | 1.47 | 0.11 | 7 |
| | | FS1-149-SB | 9/1 | 25.5 | 244 | 0.89 | ND | 11 |
| | | FS1-150-SB | 9/1 | 29.7 | 363 | 2.19 | 0.12 | 5 |
| | | FS1-151-SB | 9/1 | 37.6 | 871 | 2.23 | ND | 4 |
| | Brown bullhead | FS1-142-BB | 9/1 | 26.7 | 276 | 0.63 | 0.36 | 57 |
| | | FS1-143-BB | 9/1 | 23.4 | 158 | 0.71 | 0.06 | 9 |
| | | FS1-144-BB | 9/1 | 25.0 | 227 | 0.87 | 0.12 | 13 |
| | | FS1-145-BB | 9/1 | 24.8 | 219 | 0.91 | 0.06 | 6 |
| Upper Stretch | Smallmouth bass | FS2-245-SB | 8/30 | 32.1 | 433 | 0.81 | 0.93 | 115 |
| | | FS2-246-SB | 8/30 | 30.9 | 411 | 0.60 | 1.12 | 188 |
| | | FS2-247-SB | 8/30 | 35.1 | 539 | 0.99 | 8.36 | 841 |
| | | FS2-248-SB | 8/30 | 28.2 | 310 | 0.81 | 0.72 | 89 |
| | | FS2-249-SB | 8/30 | 29.0 | 351 | 0.83 | 0.98 | 118 |
| | | FS2-250-SB | 8/30 | 41.5 | 1032 | 1.77 | 7.47 | 422 |
| | | FS2-251-SB | 8/30 | 29.7 | 395 | 0.83 | 1.93 | 232 |
| | | FS2-252-SB | 8/30 | 33.2 | 531 | 0.85 | 4.60 | 542 |
| | | FS2-253-SB | 8/30 | 27.2 | 308 | 0.53 | 2.62 | 495 |
| | | FS2-254-SB | 8/30 | 33.9 | 597 | 0.77 | 4.86 | 628 |
| | | FS2-255-SB | 8/30 | 29.4 | 355 | 0.56 | 5.87 | 1052 |
| | | FS2-256-SB | 8/30 | 25.2 | 218 | 0.22 | 4.61 | 2105 |
| | | FS2-257-SB | 8/30 | 26.2 | 217 | 0.45 | 1.01 | 222 |
| | | FS2-258-SB | 8/30 | 30.0 | 348 | 0.65 | 7.11 | 1096 |
| | | FS2-259-SB | 8/30 | 32.4 | 557 | 0.51 | 2.19 | 434 |
| | | FS2-260-SB | 8/30 | 39.3 | 782 | 0.46 | 1.99 | 434 |
| | | FS2-261-SB | 8/30 | 40.7 | 999 | 0.96 | 12.00 | 1253 |
| | Brown bullhead | FS2-248-BB | 8/30 | 31.4 | 487 | 1.49 | 6.37 | 428 |
| | | FS2-249-BB | 8/30 | 25.8 | 251 | 1.45 | 8.18 | 564 |
| | | FS2-250-BB | 8/30 | 31.9 | 455 | 1.16 | 23.60 | 2034 |
| | | FS2-251-BB | 8/30 | 31.8 | 435 | 1.47 | 7.26 | 494 |
| | | FS2-252-BB | 8/30 | 35.0 | 651 | 2.72 | 2.48 | 91 |
| | | FS2-253-BB | 8/30 | 32.7 | 499 | 2.50 | 21.10 | 844 |
| | | FS2-254-BB | 8/30 | 31.6 | 405 | 2.11 | 22.00 | 1043 |
| | | FS2-255-BB | 8/30 | 32.4 | 423 | 2.09 | 15.10 | 722 |
| | | FS2-256-BB | 8/30 | 28.1 | 280 | 1.39 | 9.72 | 699 |
| | | FS2-257-BB | 8/30 | 32.6 | 482 | 1.73 | 12.60 | 728 |
| | | FS2-258-BB | 8/30 | 30.0 | 450 | 3.94 | 25.50 | 647 |
| | | FS2-259-BB | 8/30 | 29.3 | 392 | 2.49 | 21.10 | 847 |
| | | FS2-260-BB | 8/30 | 31.2 | 427 | 1.87 | 18.80 | 1005 |
| | | FS2-261-BB | 8/30 | 30.0 | 441 | 3.05 | 23.80 | 780 |
| | | FS2-262-BB | 8/30 | 31.0 | 396 | 1.66 | 9.90 | 596 |
| | | FS2-263-BB | 8/30 | 33.3 | 554 | 4.04 | 13.80 | 342 |
| | | FS2-264-BB | 8/30 | 30.7 | 407 | 3.15 | 19.30 | 613 |
| | | FS2-265-BB | 8/30 | 31.5 | 389 | 1.36 | 11.70 | 860 |

notes provided on page 3 of 3

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-5
2005 Resident Fish Trend Monitoring Study
Adult Resident Fish Collection Field and Laboratory Data - Smallmouth Bass and Brown Bullhead**

| Sample Area | Species | Sample ID | Date Collected | Length (cm) | Weight (g) | Lipid (%) | PCB (ppm wet) | PCB (ppm lipid) |
|----------------------------|-----------------------------|------------|----------------|-------------|------------|-----------|---------------|-----------------|
| Middle Stretch (Cont'd) | Smallmouth bass (Cont'd) | FS3-249-SB | 8/29 | 27.7 | 294 | 0.93 | 8.81 | 943 |
| | | FS3-250-SB | 8/29 | 29.2 | 338 | 1.11 | 5.43 | 489 |
| | | FS3-251-SB | 8/29 | 29.0 | 364 | 0.37 | 3.27 | 886 |
| | | FS3-252-SB | 8/29 | 25.0 | 204 | 0.95 | 5.48 | 577 |
| | | FS3-253-SB | 8/29 | 26.0 | 255 | 1.02 | 6.17 | 605 |
| | | FS3-254-SB | 8/29 | 31.2 | 461 | 0.95 | 2.99 | 315 |
| | | FS3-255-SB | 8/29 | 32.5 | 457 | 0.84 | 3.21 | 382 |
| | | FS3-256-SB | 8/29 | 31.6 | 507 | 1.07 | 7.35 | 687 |
| | | FS3-257-SB | 8/29 | 30.5 | 415 | 0.82 | 3.75 | 458 |
| | | FS3-258-SB | 8/29 | 32.1 | 493 | 0.93 | 4.33 | 468 |
| | | FS3-259-SB | 8/29 | 41.8 | 1028 | 0.99 | 5.03 | 508 |
| | | FS3-260-SB | 8/29 | 38.0 | 857 | 1.27 | 7.77 | 612 |
| | | FS3-261-SB | 8/30 | 34.2 | 652 | 0.91 | 4.64 | 509 |
| | | FS3-262-SB | 8/30 | 28.5 | 331 | 0.81 | 3.84 | 473 |
| | | FS3-263-SB | 8/30 | 32.4 | 506 | 1.28 | 7.62 | 595 |
| | | FS3-264-SB | 8/30 | 28.2 | 306 | 0.60 | 3.36 | 562 |
| | | FS3-265-SB | 8/30 | 34.1 | 561 | 0.95 | 5.22 | 547 |
| | Brown bullhead | FS3-249-BB | 8/29 | 31.1 | 464 | 3.54 | 12.10 | 342 |
| | | FS3-250-BB | 8/29 | 30.1 | 332 | 0.82 | 2.76 | 336 |
| | | FS3-251-BB | 8/29 | 29.2 | 361 | 2.73 | 13.60 | 498 |
| | | FS3-252-BB | 8/29 | 28.9 | 328 | 2.88 | 14.60 | 507 |
| | | FS3-253-BB | 8/29 | 28.2 | 332 | 2.08 | 9.06 | 436 |
| | | FS3-254-BB | 8/29 | 35.3 | 652 | 1.93 | 14.10 | 731 |
| | | FS3-255-BB | 8/29 | 30.9 | 419 | 1.92 | 7.69 | 401 |
| | | FS3-256-BB | 8/29 | 32.8 | 552 | 3.69 | 15.10 | 409 |
| | | FS3-257-BB | 8/29 | 29.5 | 363 | 2.38 | 13.90 | 584 |
| | | FS3-258-BB | 8/29 | 30.1 | 381 | 1.21 | 5.36 | 443 |
| | | FS3-259-BB | 8/29 | 32.4 | 605 | 2.52 | 10.90 | 433 |
| | | FS3-260-BB | 8/29 | 31.0 | 451 | 2.71 | 13.40 | 494 |
| | | FS3-261-BB | 8/29 | 31.6 | 456 | 0.99 | 6.03 | 610 |
| | | FS3-262-BB | 8/29 | 30.8 | 414 | 2.14 | 12.30 | 575 |
| | | FS3-263-BB | 8/29 | 30.3 | 425 | 2.46 | 14.30 | 581 |
| | | FS3-264-BB | 8/29 | 25.7 | 268 | 1.42 | 6.34 | 446 |
| | | FS3-265-BB | 8/29 | 29.2 | 382 | 1.16 | 11.60 | 1000 |
| | | FS3-266-BB | 8/29 | 27.5 | 272 | 1.21 | 5.56 | 460 |
| Lower Stretch | Smallmouth bass | FS4-200-SB | 8/29 | 35.0 | 552 | 1.22 | 4.90 | 402 |
| | | FS4-201-SB | 8/29 | 28.1 | 290 | 1.35 | 7.82 | 579 |
| | | FS4-202-SB | 8/29 | 26.4 | 290 | 0.89 | 4.08 | 457 |
| | | FS4-203-SB | 8/29 | 26.2 | 254 | 0.77 | 3.31 | 428 |
| | | FS4-204-SB | 8/29 | 26.6 | 298 | 0.78 | 2.46 | 317 |
| | | FS4-205-SB | 8/29 | 30.3 | 391 | 0.87 | 3.70 | 423 |
| | | FS4-206-SB | 8/29 | 32.2 | 487 | 0.57 | 2.88 | 506 |
| | | FS4-207-SB | 8/29 | 40.5 | 1050 | 1.55 | 7.03 | 454 |
| | | FS4-208-SB | 8/29 | 41.6 | 1075 | 0.88 | 3.38 | 385 |
| | | FS4-209-SB | 8/29 | 39.5 | 1037 | 1.19 | 4.60 | 387 |
| | | FS4-210-SB | 8/29 | 46.0 | 1502 | 2.60 | 12.40 | 477 |
| | | FS4-211-SB | 8/30 | 40.7 | 992 | 1.06 | 3.85 | 363 |

notes provided on page 3 of 3

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-5
2005 Resident Fish Trend Monitoring Study
Adult Resident Fish Collection Field and Laboratory Data - Smallmouth Bass and Brown Bullhead**

| Sample Area | Species | Sample ID | Date Collected | Length (cm) | Weight (g) | Lipid (%) | PCB (ppm wet) | PCB (ppm lipid) |
|---------------------------|-----------------------------|------------------------|----------------|-------------|------------|-----------|---------------|-----------------|
| Lower Stretch (Cont'd) | Smallmouth bass (Cont'd) | FS4-212-SB | 8/30 | 36.2 | 676 | 0.77 | 4.99 | 651 |
| | | FS4-213-SB | 8/30 | 32.9 | 523 | 0.92 | 5.50 | 597 |
| | | FS4-214-SB | 8/30 | 25.0 | 200 | 0.51 | 3.20 | 631 |
| | | FS4-215-SB | 8/30 | 25.5 | 251 | 0.59 | 3.55 | 599 |
| | | FS4-216-SB | 8/30 | 28.2 | 303 | 0.76 | 4.88 | 641 |
| | Brown bullhead | FS4-220-BB | 8/29 | 29.5 | 358 | 1.18 | 4.74 | 402 |
| | | FS4-221-BB | 8/29 | 28.6 | 298 | 2.15 | 8.81 | 410 |
| | | FS4-222-BB | 8/29 | 30.8 | 432 | 1.58 | 5.11 | 323 |
| | | FS4-223-BB | 8/29 | 30.6 | 419 | 0.95 | 5.42 | 573 |
| | | FS4-224-BB | 8/29 | 28.5 | 353 | 1.36 | 3.90 | 287 |
| | | FS4-225-BB | 8/29 | 31.5 | 528 | 3.41 | 16.00 | 469 |
| | | FS4-226-BB | 8/29 | 28.6 | 354 | 2.46 | 9.19 | 374 |
| | | FS4-227-BB | 8/29 | 28.3 | 387 | 2.42 | 7.05 | 291 |
| | | FS4-228-BB | 8/29 | 29.1 | 413 | 1.80 | 4.90 | 272 |
| | | FS4-229-BB | 8/29 | 30.2 | 412 | 3.84 | 12.90 | 336 |
| | | FS4-230-BB | 8/29 | 28.8 | 439 | 1.39 | 5.15 | 371 |
| | | FS4-231-BB | 8/29 | 30.3 | 388 | 2.13 | 6.76 | 317 |
| | | FS4-232-BB | 8/29 | 31.5 | 474 | 3.19 | 13.20 | 414 |
| | | FS4-233-BB | 8/29 | 27.8 | 383 | 3.18 | 13.60 | 428 |
| | | FS4-234-BB | 8/29 | 30.1 | 480 | 4.56 | 14.30 | 314 |
| | | FS4-235-BB | 8/29 | 28.9 | 329 | 2.85 | 10.10 | 354 |
| | | FS4-236-BB | 8/29 | 27.4 | 286 | 0.73 | 3.36 | 459 |
| | | FS4-237-BB | 8/29 | 30.3 | 406 | 2.12 | 9.95 | 469 |
| Power Canal | Smallmouth bass | FS6-35-SB | 9/20 | 41.6 | 795 | 0.19 | 1.19 | 613 |
| | | FS6-36-SB | 9/20 | 36.1 | 617 | 0.47 | 0.40 | 86 |
| | | FS6-37-SB | 9/20 | 39.3 | 825 | 0.12 | 0.26 | 223 |
| | | FS6-38-SB | 9/20 | 29.3 | 294 | 0.24 | 0.17 | 72 |
| | | FS6-39-SB | 9/20 | 27.2 | 243 | 0.05 | ND | --- |
| | | FS6-40-SB | 9/20 | 28.5 | 285 | 0.30 | ND | 34 |
| | | FS6-41-SB | 9/20 | 43.1 | 1212 | 0.94 | 0.44 | 46 |
| | | FS6-42-SB | 9/20 | 34.0 | 622 | 0.53 | 0.25 | 47 |
| | | FS6-43-SB | 9/20 | 33.0 | 462 | 0.79 | 0.35 | 44 |
| | | FS6-44-SB ⁷ | 9/20 | 41.8 | 962 | 0.75 | 0.49 | 65 |
| | | FS6-45-SB ⁷ | 9/20 | 42.9 | 967 | 0.92 | 0.92 | 100 |
| | | FS6-46-SB ⁷ | 9/20 | 41.1 | 1012 | 0.73 | 0.71 | 97 |
| | | FS6-47-SB ⁷ | 9/21 | 40.8 | 792 | 0.35 | 0.61 | 173 |
| | | FS6-48-SB ⁷ | 9/21 | 41.4 | 722 | 0.30 | 0.97 | 325 |
| | | FS6-49-SB ⁷ | 9/21 | 44.3 | 941 | 0.20 | 1.61 | 817 |
| | | FS6-50-SB ⁷ | 9/21 | 45.0 | 1339 | 0.74 | 0.68 | 92 |
| | | FS6-51-SB ⁷ | 9/21 | 41.2 | 871 | 0.653 | 0.47 | 72 |

Notes:

1. Units: cm = centimeters, g = grams, ppm = parts per million
2. ND = not detected; Detection limits range from 0.2 to 0.71 ppm for non-detected samples.
3. '---' = PCB lipid concentration not computed due to unreasonably low lipid content of the sample (<0.1%).
4. PCB concentrations quantified on an Aroclor basis.
5. If PCB concentration was not detected, PCB concentration on a wet weight basis was set to half the detection limit prior to computing PCB concentration on a lipid basis.
6. Smallmouth bass fillets - skin-on, scales-off; brown bullhead fillets - skin-off
7. Collected with a gill net; all other fish collected with a boat-mounted electrofishing unit.
8. Sampling locations shown on Figures 2-12 and 2-13.

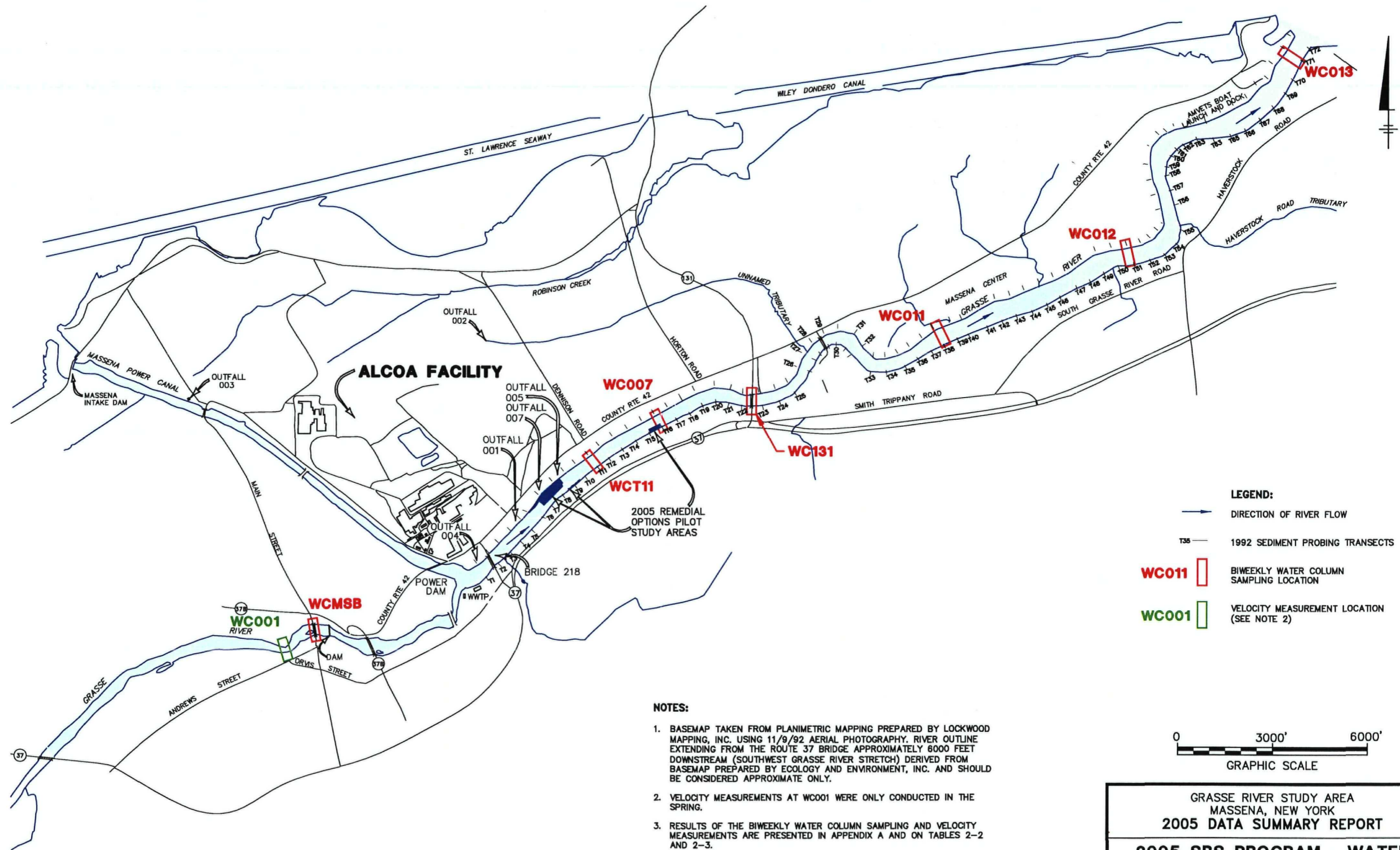
**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 2-6
2005 Resident Fish Trend Monitoring Study
Resident Fish Collection Field and Laboratory Data - Young-of-Year Spottail Shiner**

| Species | Sample Area | Sample ID | Date Collected | Fish per Sample | Length Range (cm) | Weight (g) | Lipid (%) | PCB (ppm wet) | PCB (ppm lipid) |
|-----------------|-------------------------|-----------|----------------|-----------------|-------------------|------------|-----------|---------------|-----------------|
| Spottail Shiner | Background Stretch | FS1-34-SS | 9/1 | 25 | 5.1 - 6.1 | 34 | 5.68 | 0.17 | 3.0 |
| | | FS1-35-SS | 9/1 | 25 | 5.5 - 6.4 | 41 | 4.89 | 0.13 | 2.7 |
| | | FS1-36-SS | 9/1 | 25 | 4.9 - 5.8 | 34 | 5.21 | 0.14 | 2.7 |
| | Near Outfall 001 | FS2-49-SS | 9/20 | 20 | 4.2 - 5.7 | 20 | 3.27 | 7.84 | 239.8 |
| | | FS2-50-SS | 9/20 | 20 | 4.4 - 6.2 | 20 | 4.27 | 7.71 | 180.6 |
| | | FS2-51-SS | 9/20 | 40 | 3.4 - 4.2 | 16 | 3.4 | 5.54 | 162.9 |
| | Near Unnamed Tributary | FS3-37-SS | 9/20 | 19 | 3.7 - 5.7 | 23 | 4.61 | 19.70 | 427.3 |
| | | FS3-38-SS | 9/20 | 19 | 4.6 - 5.9 | 23 | 4.64 | 18.60 | 400.9 |
| | | FS3-39-SS | 9/20 | 19 | 3.9 - 6.0 | 22 | 4.65 | 20.30 | 436.6 |
| | Near Grasse River Mouth | FS5-34-SS | 9/21 | 16 | 3.0 - 5.7 | 16 | 3.96 | 8.87 | 224.0 |
| | | FS5-35-SS | 9/21 | 17 | 3.1 - 5.8 | 16 | 3.34 | 9.48 | 283.8 |
| | | FS5-36-SS | 9/21 | 17 | 3.1 - 6.0 | 17 | 3.73 | 9.07 | 243.2 |

Notes:

1. Units: cm = centimeters, g = grams, ppm = parts per million
2. PCB concentrations quantified on an Aroclor basis.
3. Spottail shiner - whole-body composites
4. Sampling locations shown on Figure 2-14.



GRASSE RIVER STUDY AREA
 MASSENA, NEW YORK
 2005 DATA SUMMARY REPORT

**2005 SRS PROGRAM - WATER
 COLUMN MONITORING LOCATIONS**

ALCOA

FIGURE
2-1

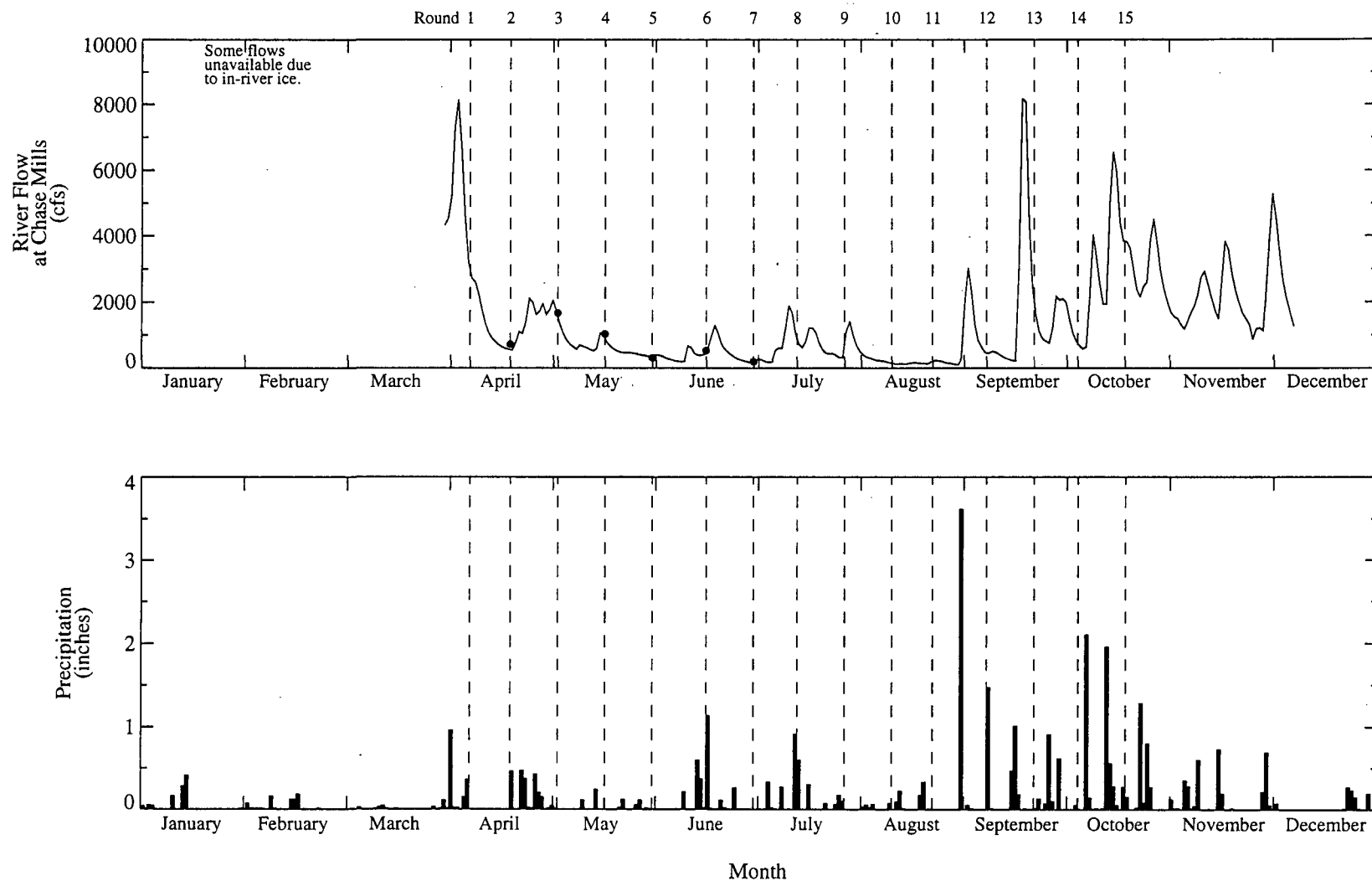


Figure 2-2. Grasse River Flow and Precipitation Information from 2005

Grasse River flow measured at water sampling Transect WC001 (filled circles).

Grasse River flow based on daily averages of flow records from the USGS gage at Chase Mills.

Grasse River precipitation measured near Outfall 007. Rainfall data unavailable from 8/23-8/30.

Data tables: climate, riverflow_chasemills, riverflow_tapedown, water_iupac

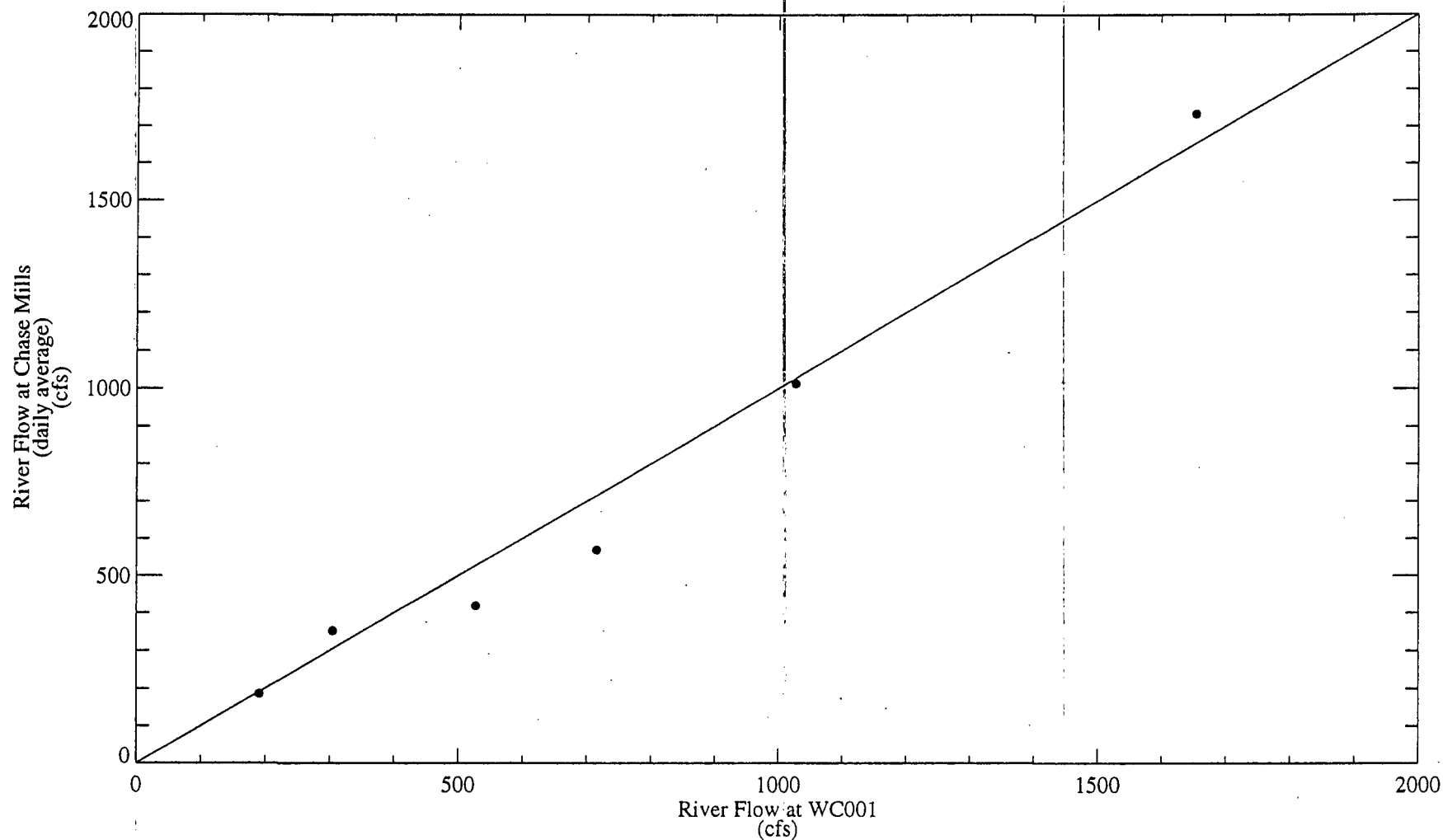


Figure 2-3. Method Comparison for Measuring/Estimating Grasse River Flows in 2005

Grasse River flows were measured at USGS gage at Chase Mills, NY.

Grasse River flows were obtained at WC001 by velocity profiling during routine water column monitoring.

Flow measurements at WC001 were unavailable during Round 1 and discontinued after Round 7 of monitoring.

Data tables: riverflow_tapedown, riverflow_chasemills

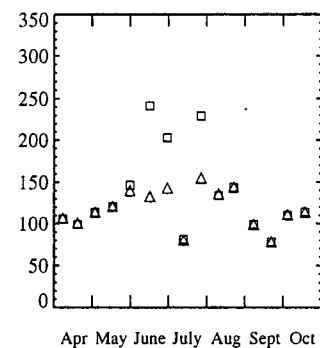
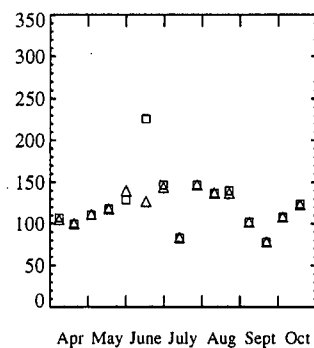
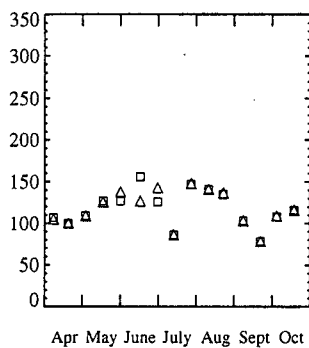
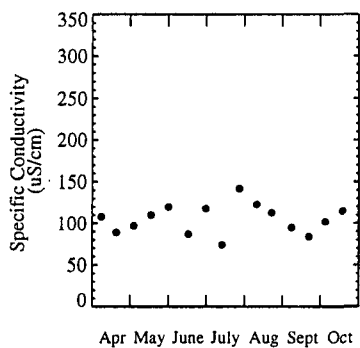
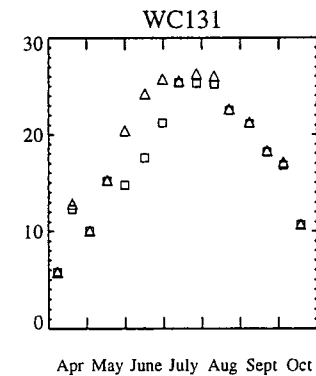
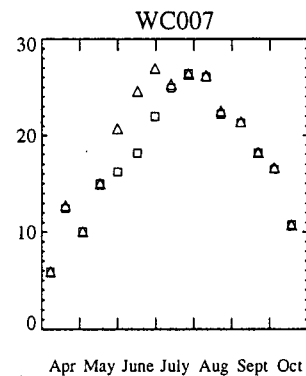
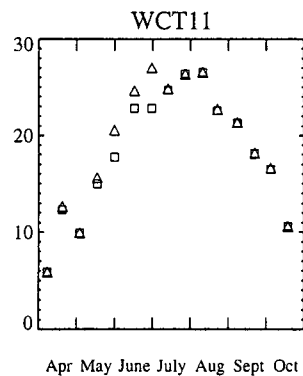
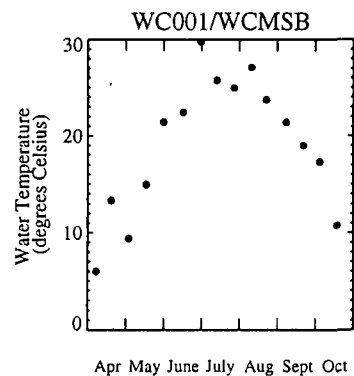
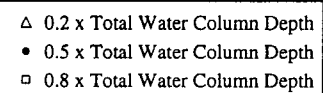


Figure 2-4. Water Temperature and Specific Conductivity Measurements During Water Column Routine Monitoring in 2005
Locations: WC001/WCMSB, WCT11, WC007, WC131, WC011, WC012, and WC013

Data table: water_field



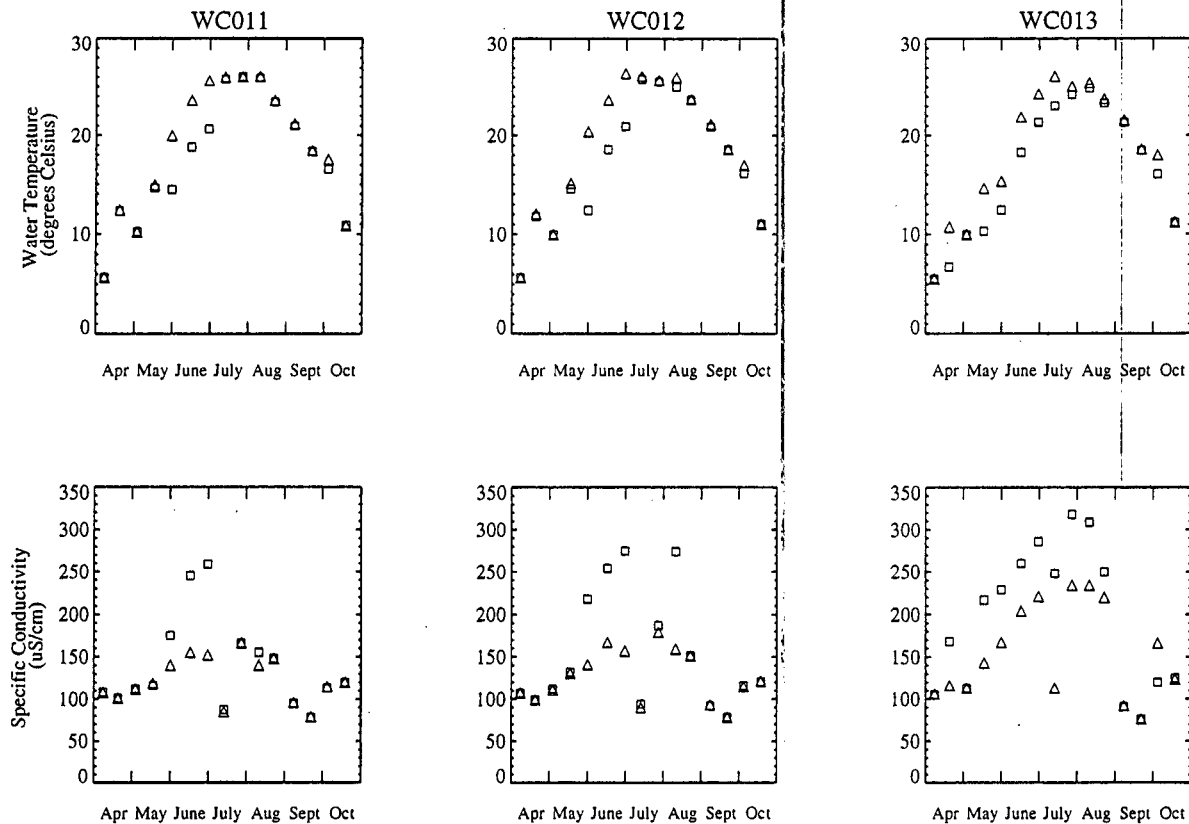


Figure 2-4. Water Temperature and Specific Conductivity Measurements During Water Column Routine Monitoring in 2005

Locations: WC001/WCMSB, WCT11, WC007, WC131, WC011, WC012, and WC013

Data table: water_field

- △ 0.2 x Total Water Column Depth
- 0.5 x Total Water Column Depth
- 0.8 x Total Water Column Depth

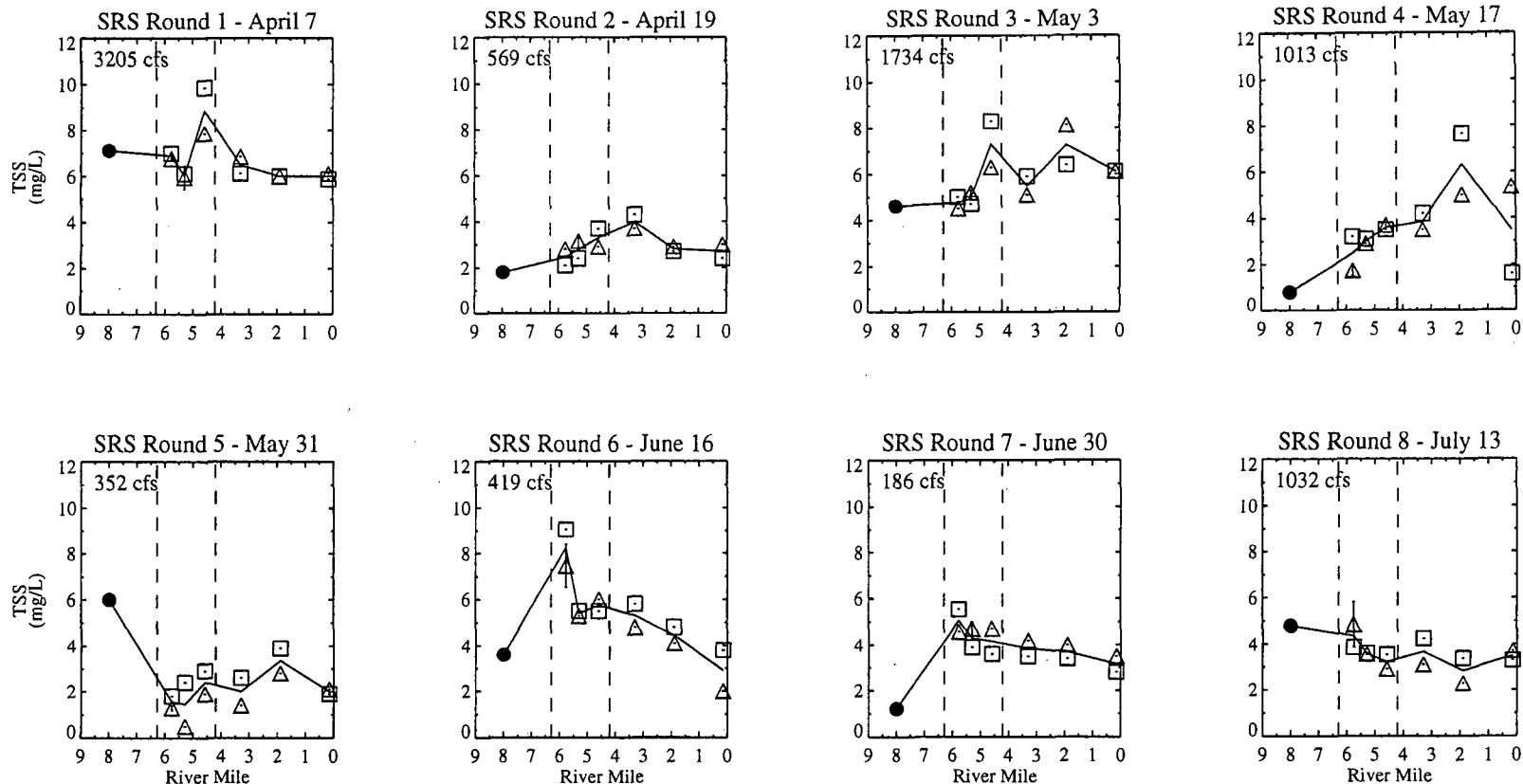


Figure 2-5. Spatial Distribution of TSS Concentrations Measured During the 2005 SRS Program

Vertical dashed lines represent approximate locations of Outfall 001 (left) and the Unnamed Tributary (right).

Daily average flows indicated in upper right corner. Flows measured at the USGS gage at Chase Mills.

Values below the detection limit set to half the detection limit. Duplicates averaged (error bar represents range).

Data tables: riverflow_ChaseMills, water_iupac

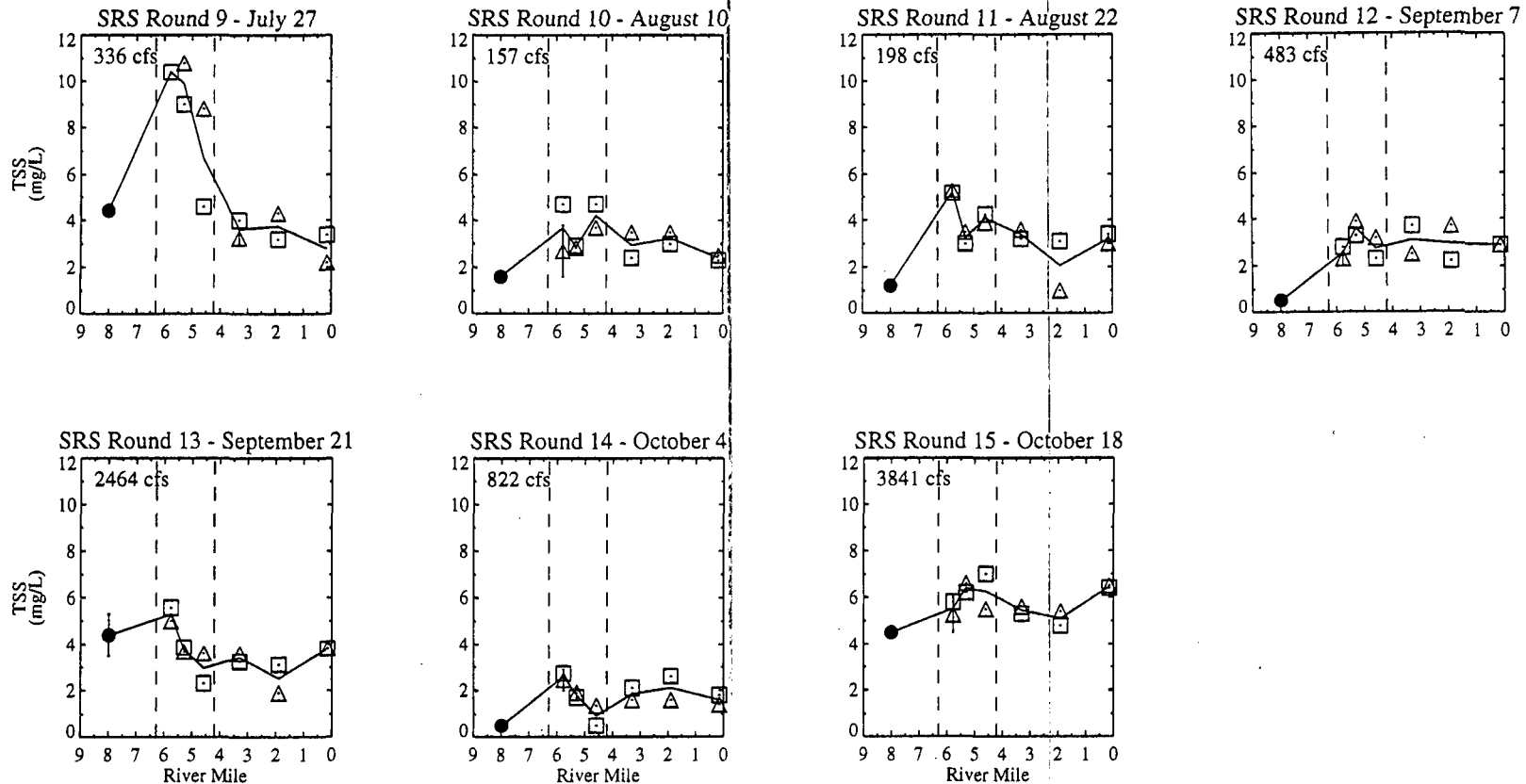


Figure 2-5. Spatial Distribution of TSS Concentrations Measured During the 2005 SRS Program

Vertical dashed lines represent approximate locations of Outfall 001 (left) and the Unnamed Tributary (right).

Daily average flows indicated in upper right corner. Flows measured at the USGS gage at Chase Mills.

Values below the detection limit set to half the detection limit. Duplicates averaged (error bar represents range).

Data tables: riverflow_ChaseMills, water_iupac

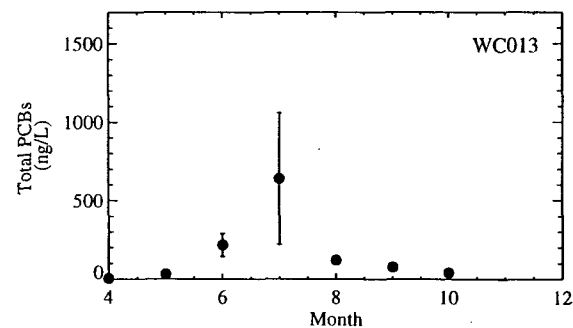
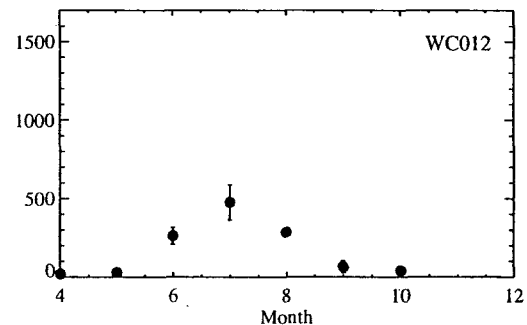
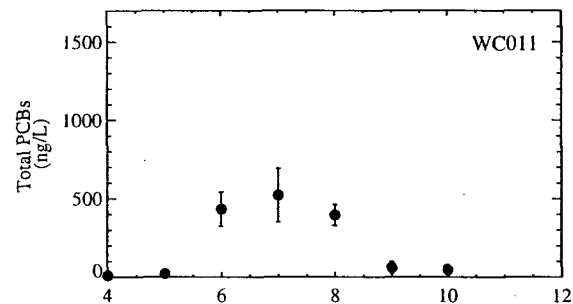
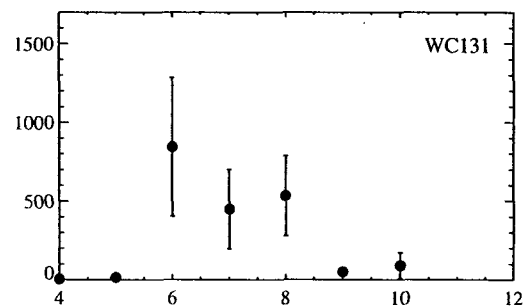
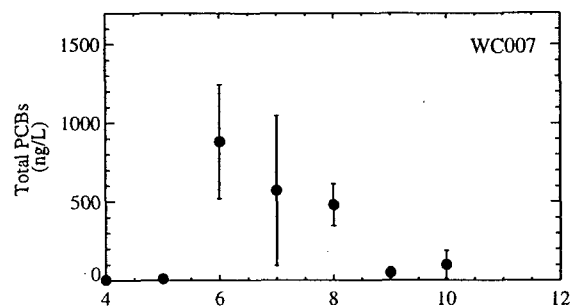
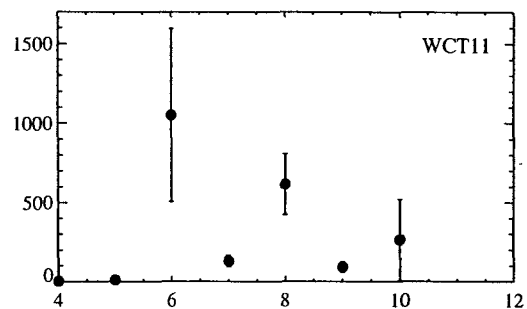
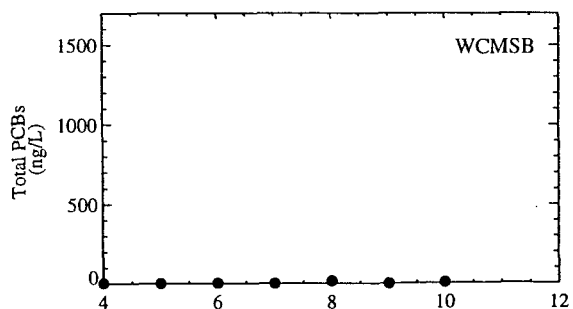


Figure 2-6. Monthly Average PCB Concentrations at Water Column Sampling Locations in 2005

Data represent surface samples collected at 0.2 times the total water depth (0.5 x depth for WCM5B)

Error bar represents range of means; duplicates averaged with original sample

Data table: water_iupac

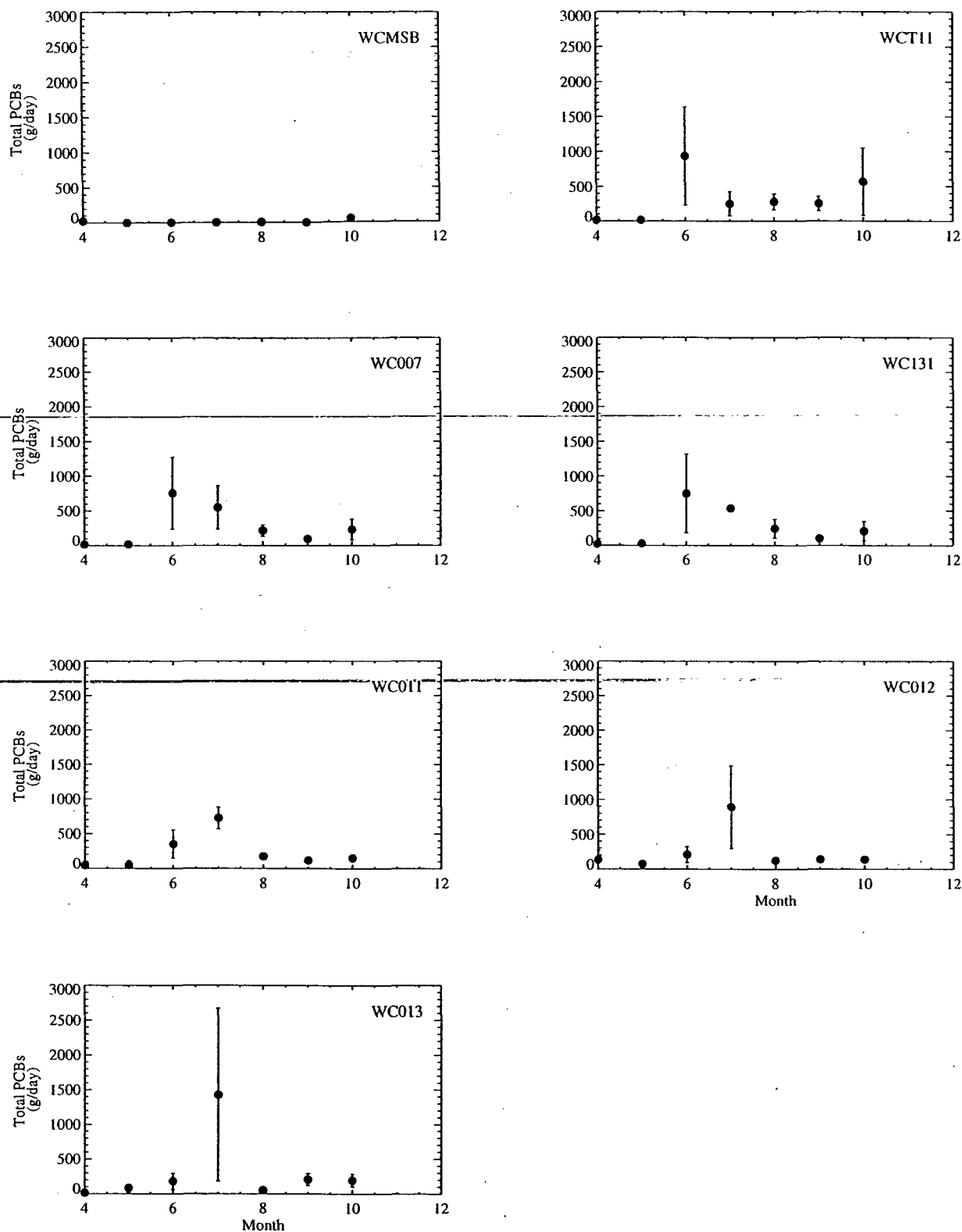


Figure 2-7. Monthly Average PCB Mass Fluxes at Water Column Sampling Locations in 2005

Data represent surface samples collected at 0.2 times the total water depth (0.5 x depth for WCMSB)

Error bar represents range of means; duplicates averaged with original sample

Data tables: riverflow_ChaseMills, water_iupac

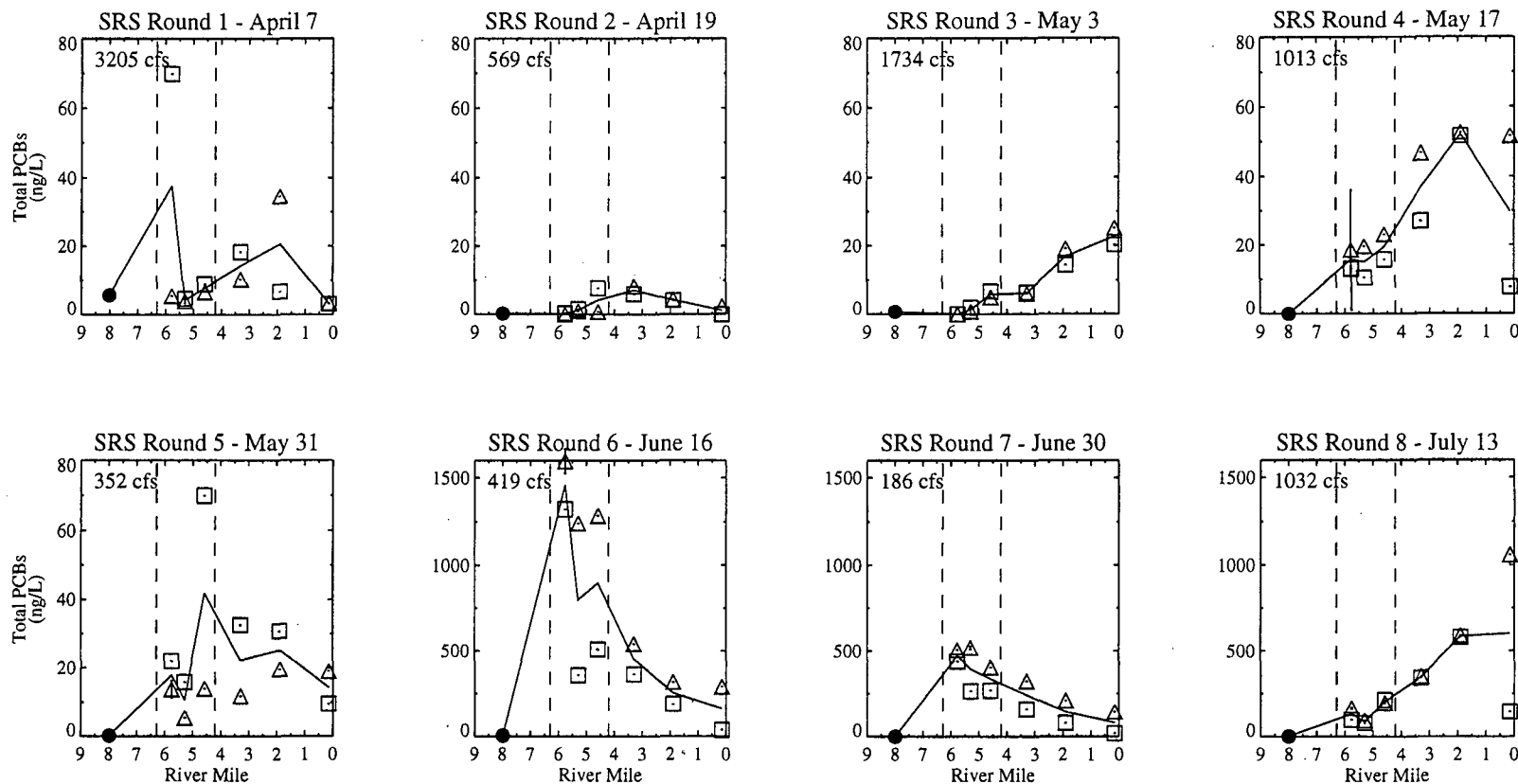


Figure 2-8. Spatial Distribution of Total PCBs in Water Samples Collected During the 2005 SRS Program

Values represent unfiltered water column sample results.

Vertical dashed lines represent approximate locations of Outfall 001 (left) and the Unnamed Tributary (right).

Estimated daily average flows indicated in upper left corner. Flows measured at the USGS gage at Chase Mills.

Duplicates averaged (error bar represents range).

Data tables: riverflow_ChaseMills, water_iupac

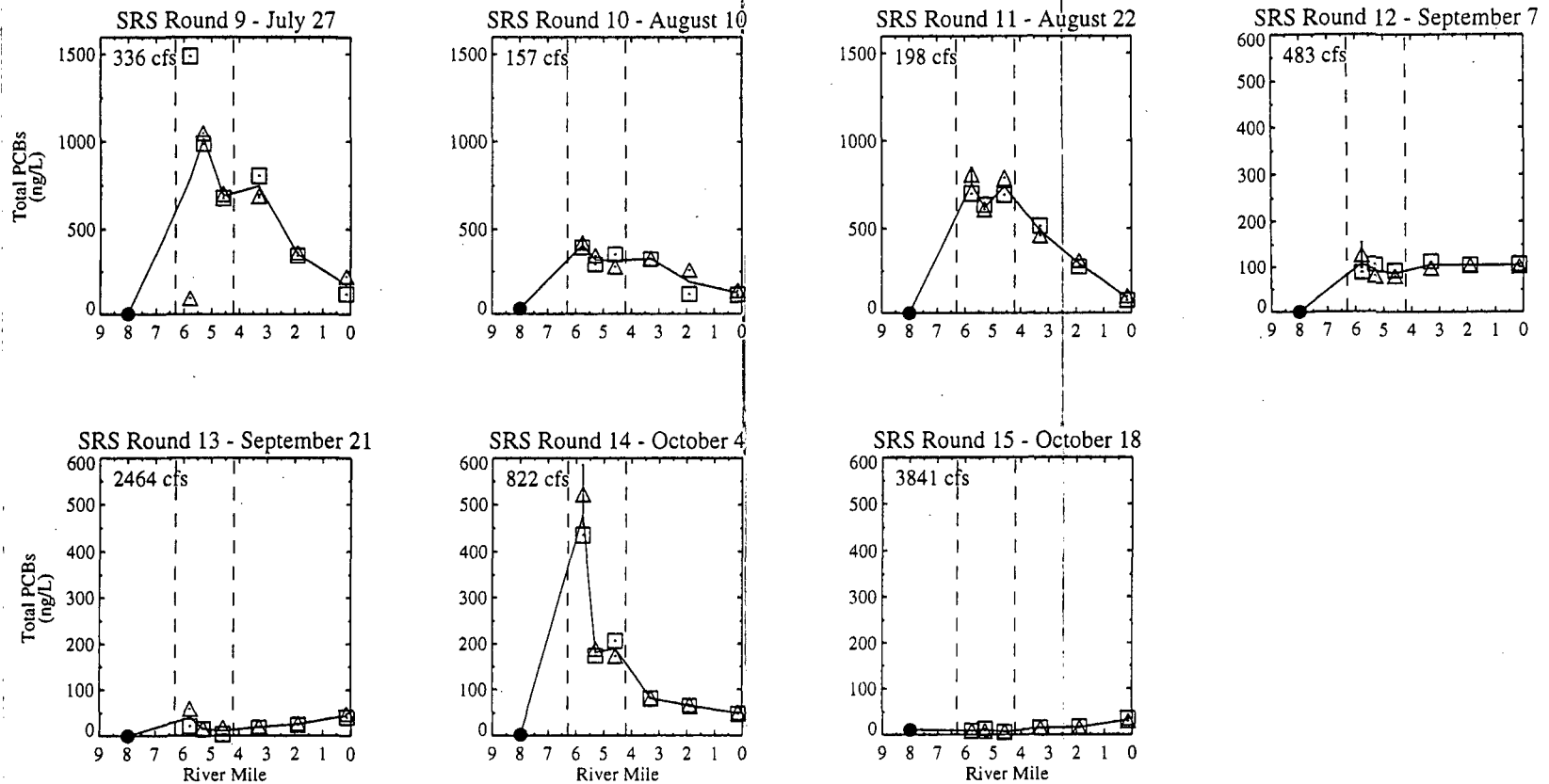


Figure 2-8. Spatial Distribution of Total PCBs in Water Samples Collected During the 2005 SRS Program

Values represent unfiltered water column sample results.

Vertical dashed lines represent approximate locations of Outfall 001 (left) and the Unnamed Tributary (right).

Estimated daily average flows indicated in upper left corner. Flows measured at the USGS gage at Chase Mills.

Duplicates averaged (error bar represents range).

Data tables: riverflow_ChaseMills, water_iupac

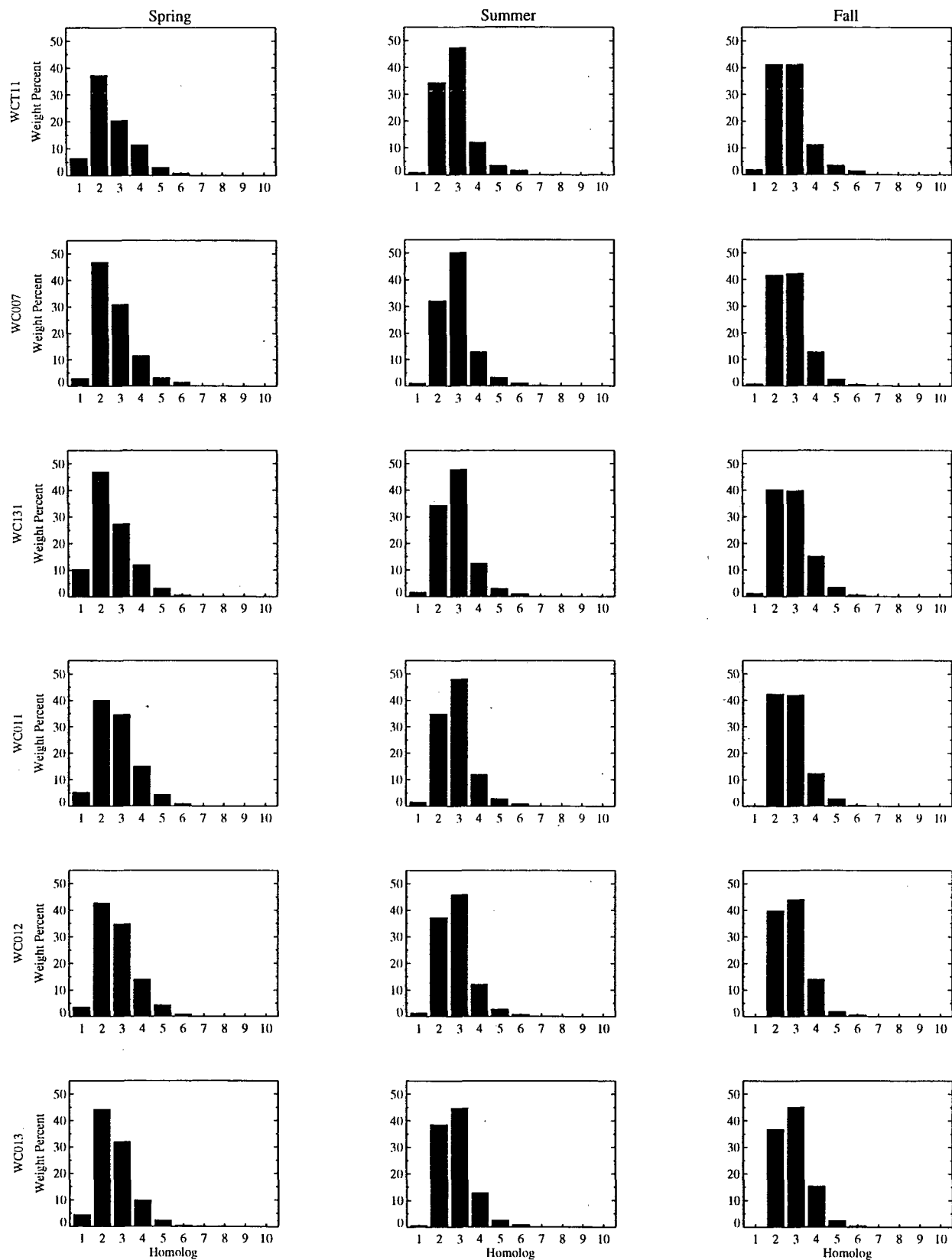


Figure 2-9. Average Homolog Distributions in Water Samples Collected in 2005

Spring - April, May & June; Summer - July & August; Fall - September & October
Bars represent average water column results at each location for each season.

Data table: water_iupac

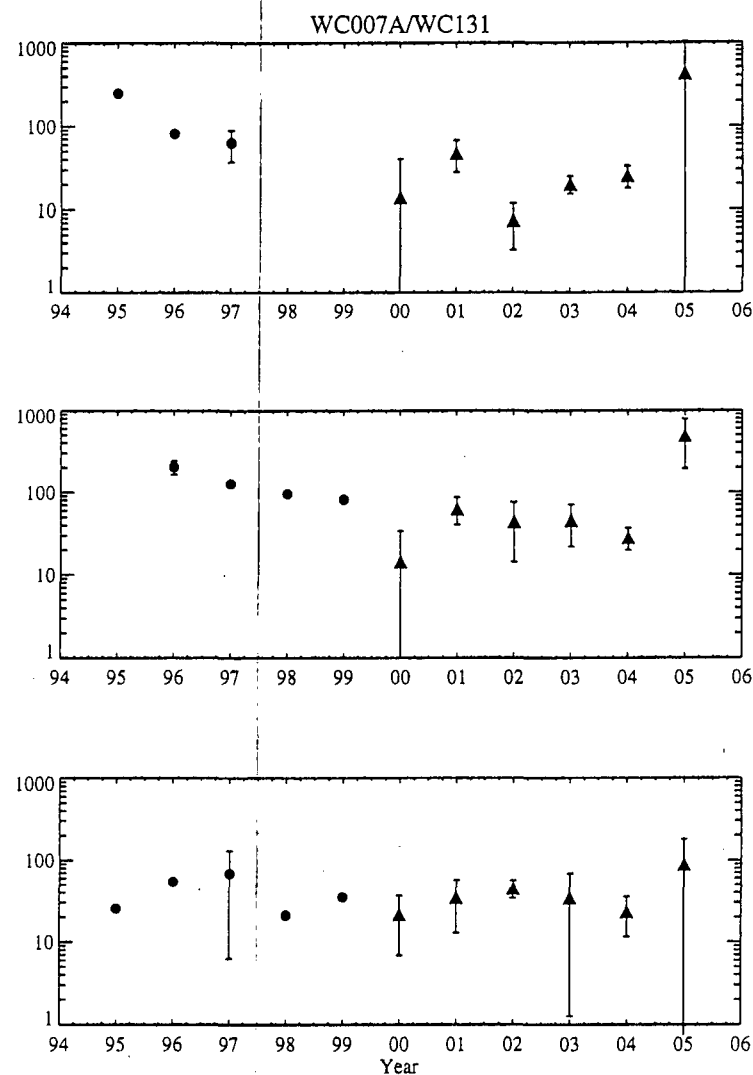
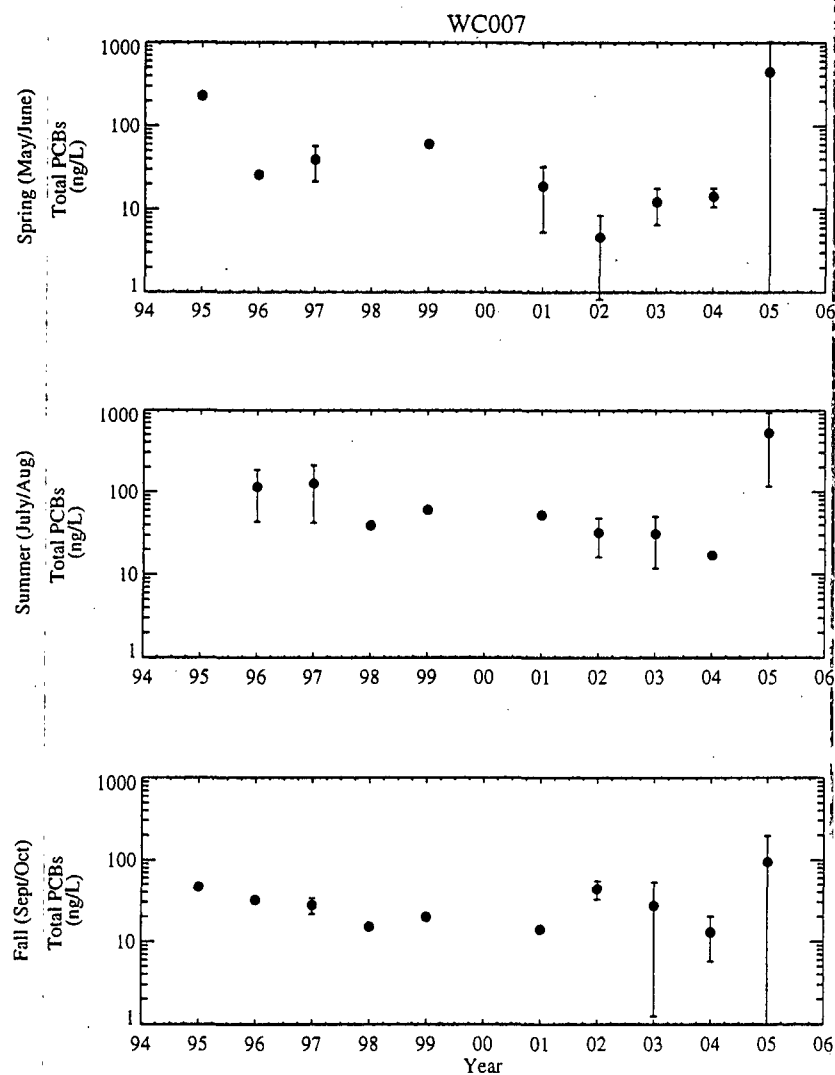


Figure 2-10. Seasonal Average Water Column PCB Concentrations During Non-Stratified Periods

Data represent samples collected when river flow was less than or equal to 2200 cfs.

1995 to 1999 data represent composite samples collected during non-stratified periods.

2000 to 2005 data represent surface samples collected at 0.2 times the total water depth.

Error bars represent two standard errors of the mean; no error bars shown if sample count is fewer than three.

Triangles represent surface samples collected at WC131. Duplicates averaged; data collected on same day averaged.

Data tables: riverflow_hist, water_bz, water_peak, water_iupac

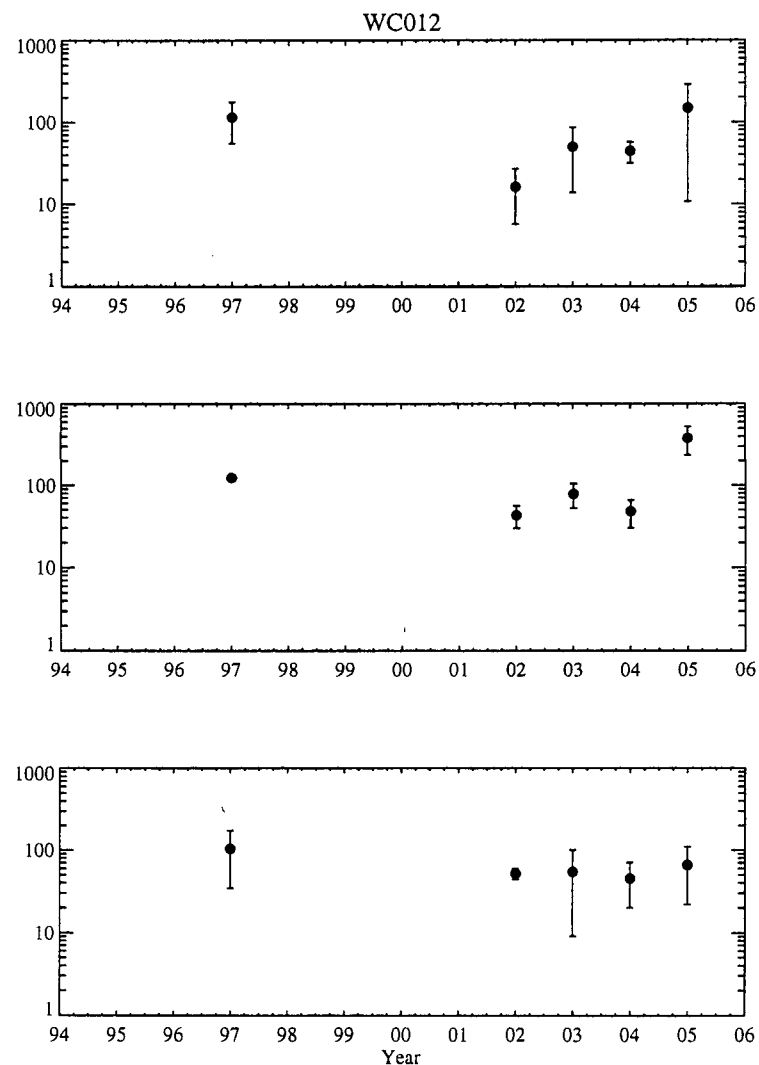
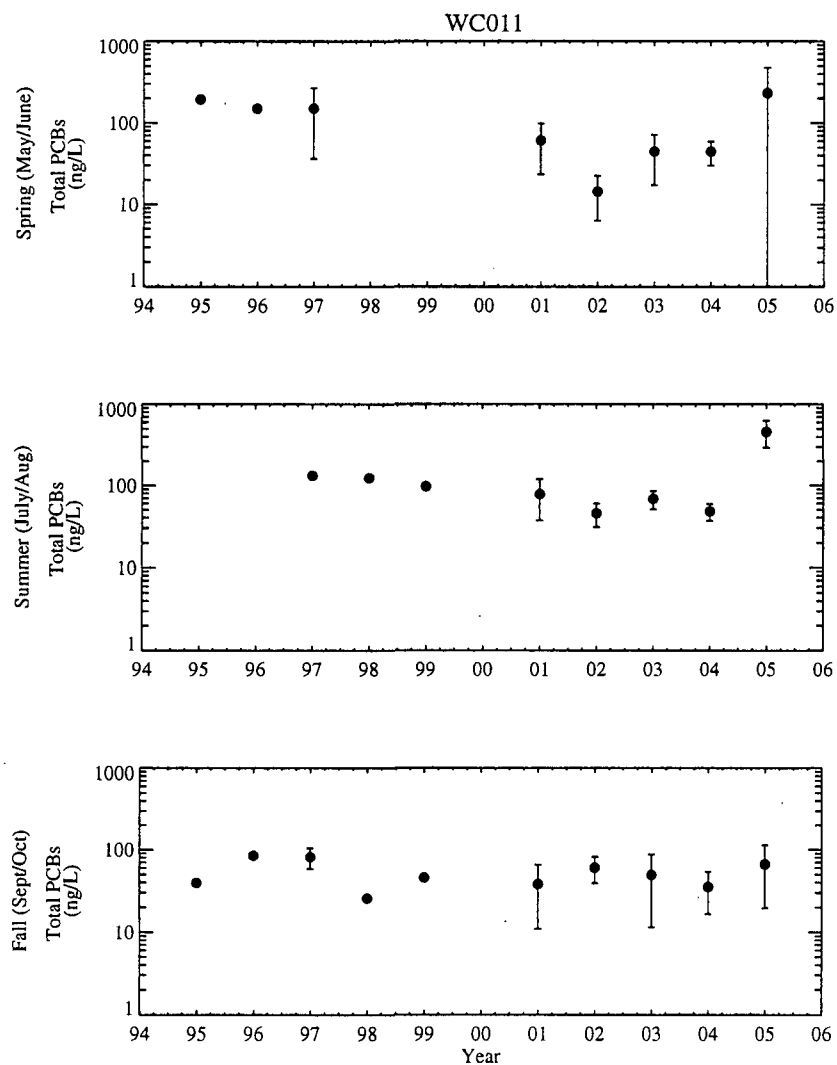


Figure 2-10. Seasonal Average Water Column PCB Concentrations During Non-Stratified Periods

Data represent samples collected when river flow was less than or equal to 2200 cfs.

1995 to 1999 data represent composite samples collected during non-stratified periods.

2000 to 2005 data represent surface samples collected at 0.2 times the total water depth.

Error bars represent two standard errors of the mean; no error bars shown if sample count is fewer than three.

Duplicates averaged; data collected on same day averaged.

Data tables: riverflow_hist, water_bz, water_peak, water_iupac

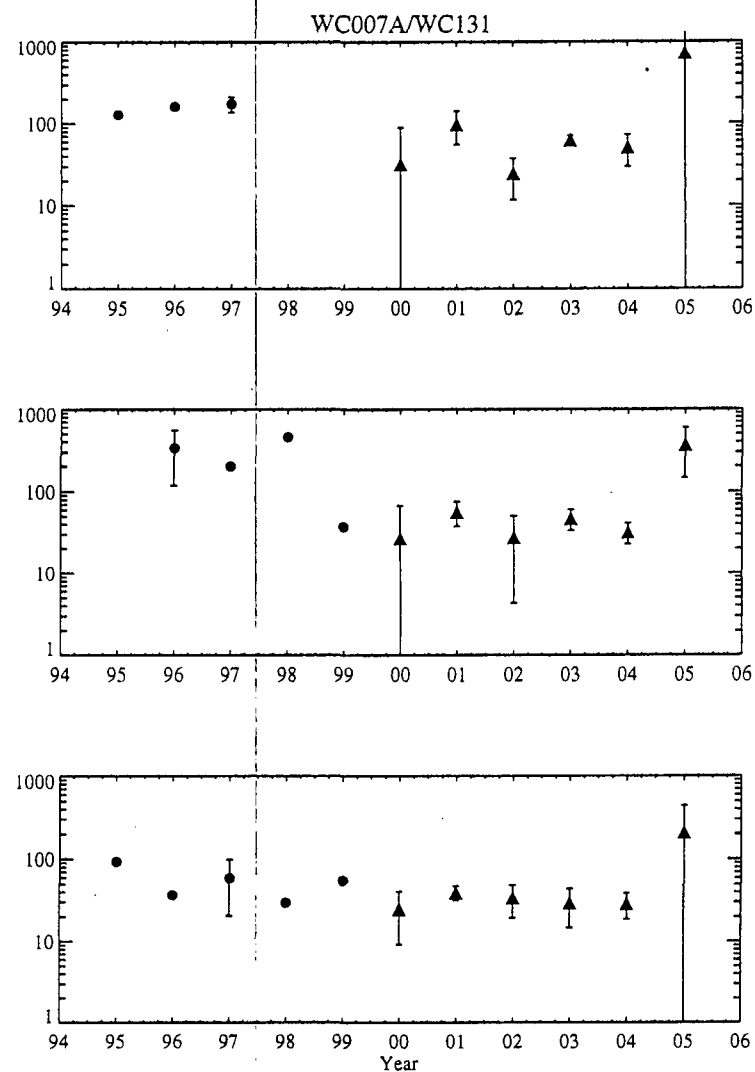
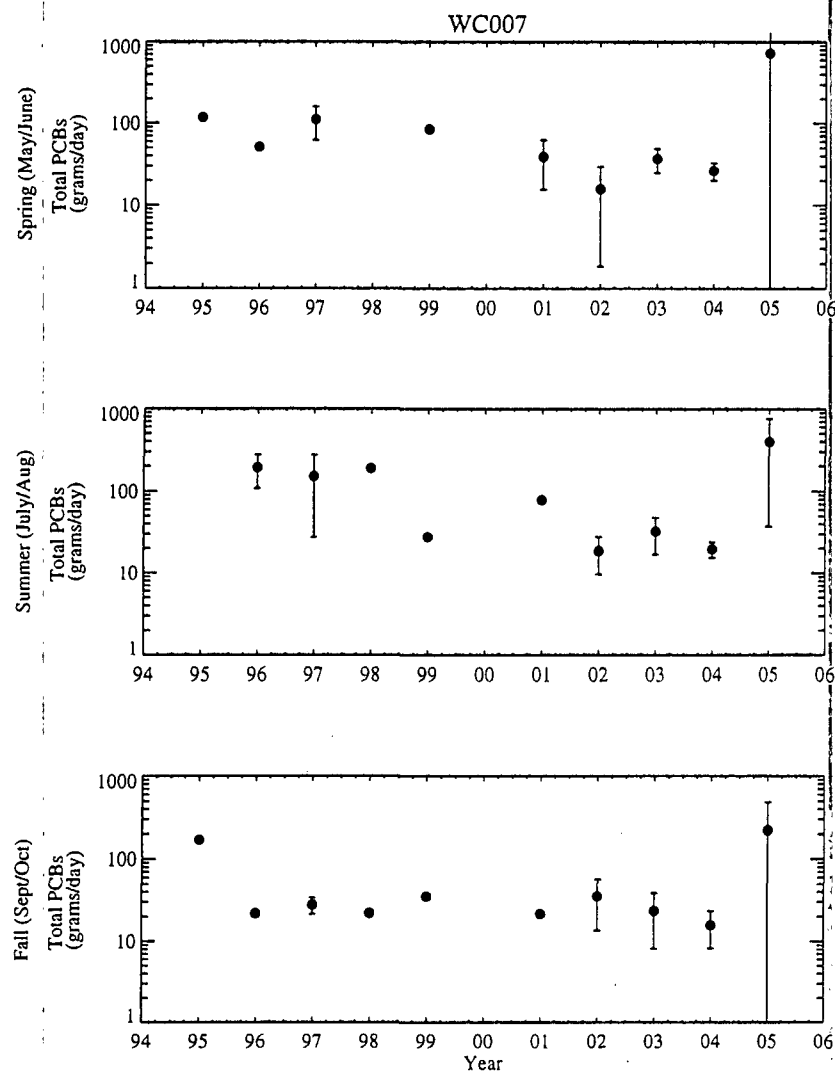


Figure 2-11. Seasonal Average Water Column PCB Mass Fluxes During Non-Stratified Periods

Data represent samples collected when river flow was less than or equal to 2200 cfs.

1995 to 1999 data represent composite samples collected during non-stratified periods.

2000 to 2005 data represent surface samples collected at 0.2 times the total water depth.

Error bars represent two standard errors of the mean; no error bars shown if sample count is fewer than three.

Triangles represent surface samples collected at WC131. Duplicates averaged; data collected on same day averaged.

Data tables: riverflow_hist, water_bz, water_peak, water_iupac

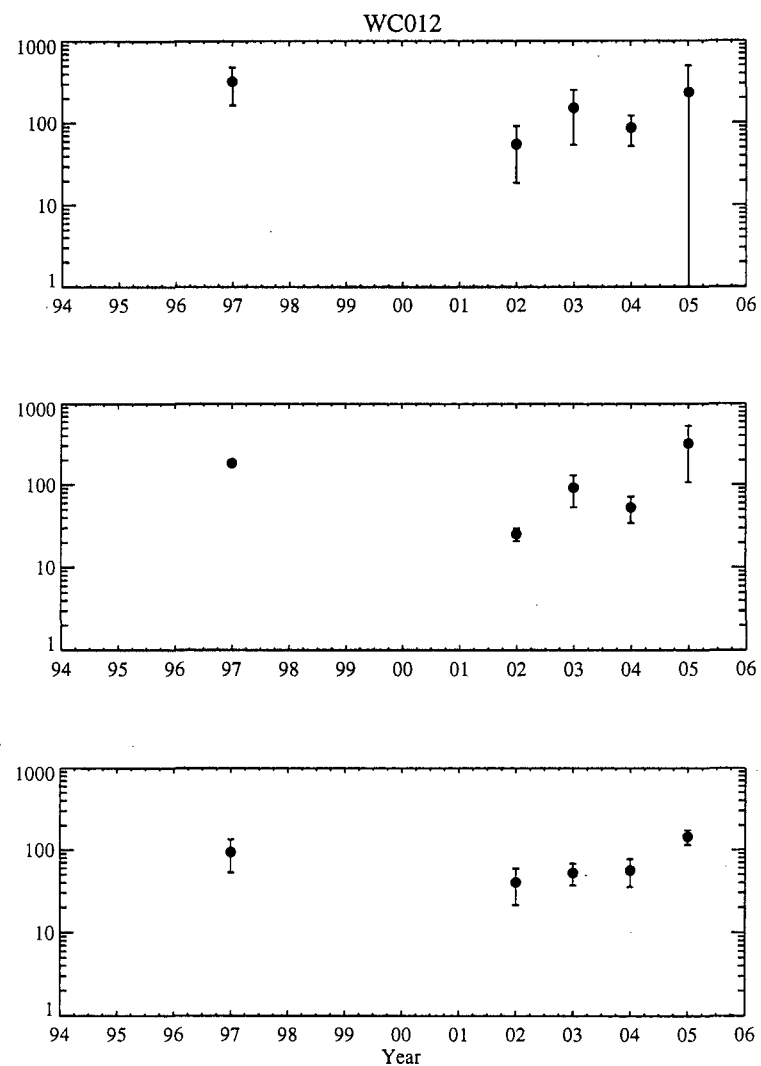
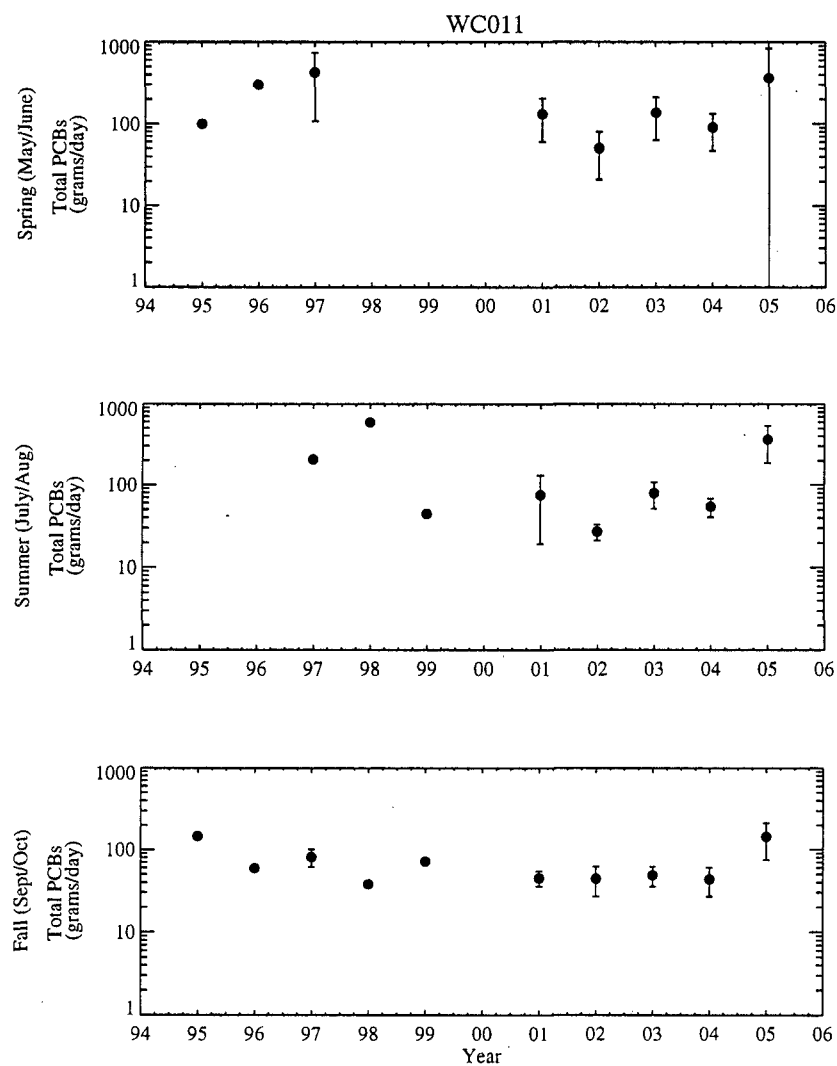


Figure 2-11. Seasonal Average Water Column PCB Mass Fluxes During Non-Stratified Periods

Data represent samples collected when river flow was less than or equal to 2200 cfs.

1995 to 1999 data represent composite samples collected during non-stratified periods.

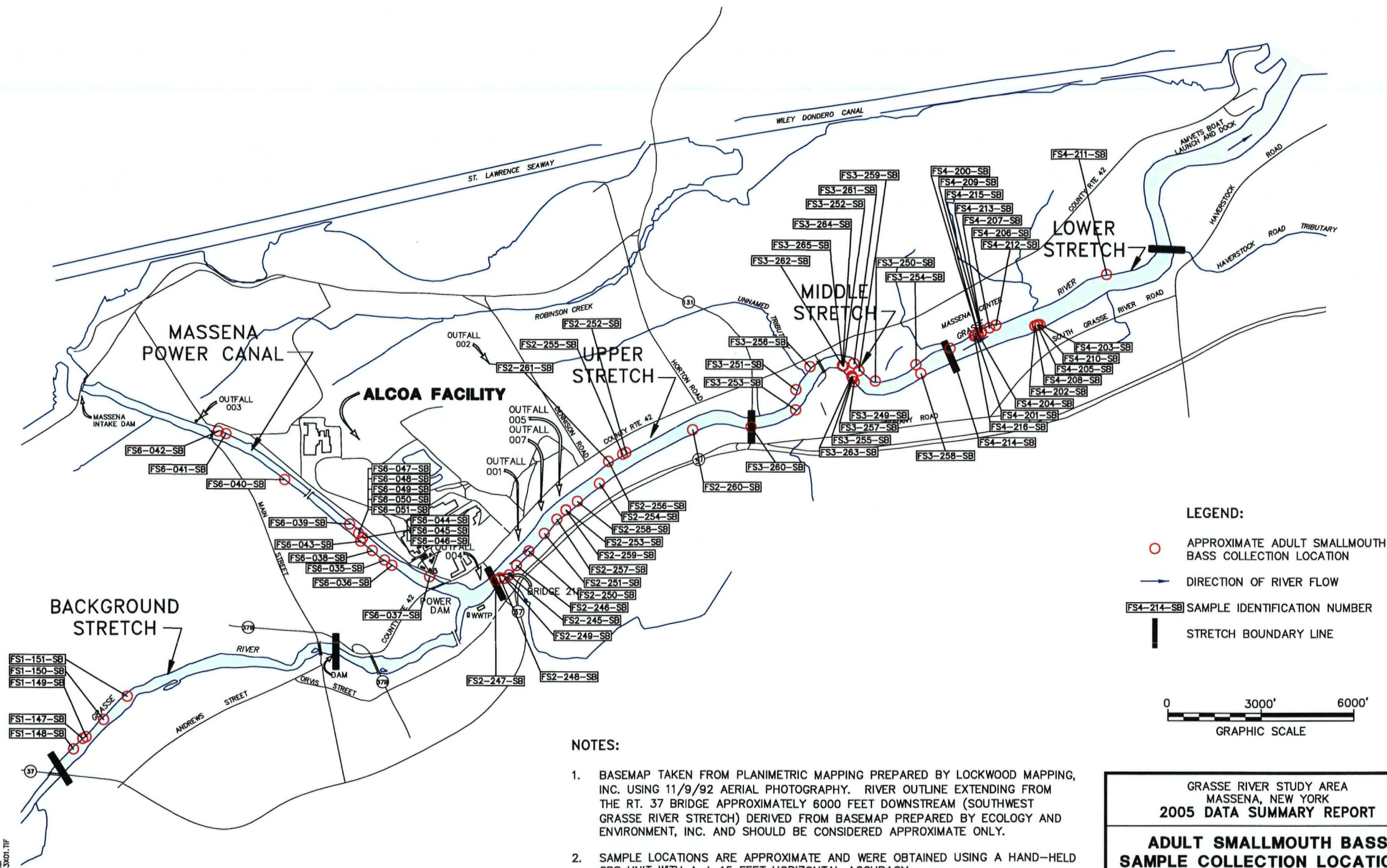
2000 to 2005 data represent surface samples collected at 0.2 times the total water depth.

Error bars represent two standard errors of the mean; no error bars shown if sample count is fewer than three.

Duplicates averaged; data collected on same day averaged.

Data tables: riverflow_hist, water_bz, water_peak, water_iupac

PROJECTNAME: 10813000
 XREFS: 10813000
 10813001.TIF



GRASSE RIVER STUDY AREA
 MASSENA, NEW YORK
2005 DATA SUMMARY REPORT

**ADULT SMALLMOUTH BASS
 SAMPLE COLLECTION LOCATIONS**


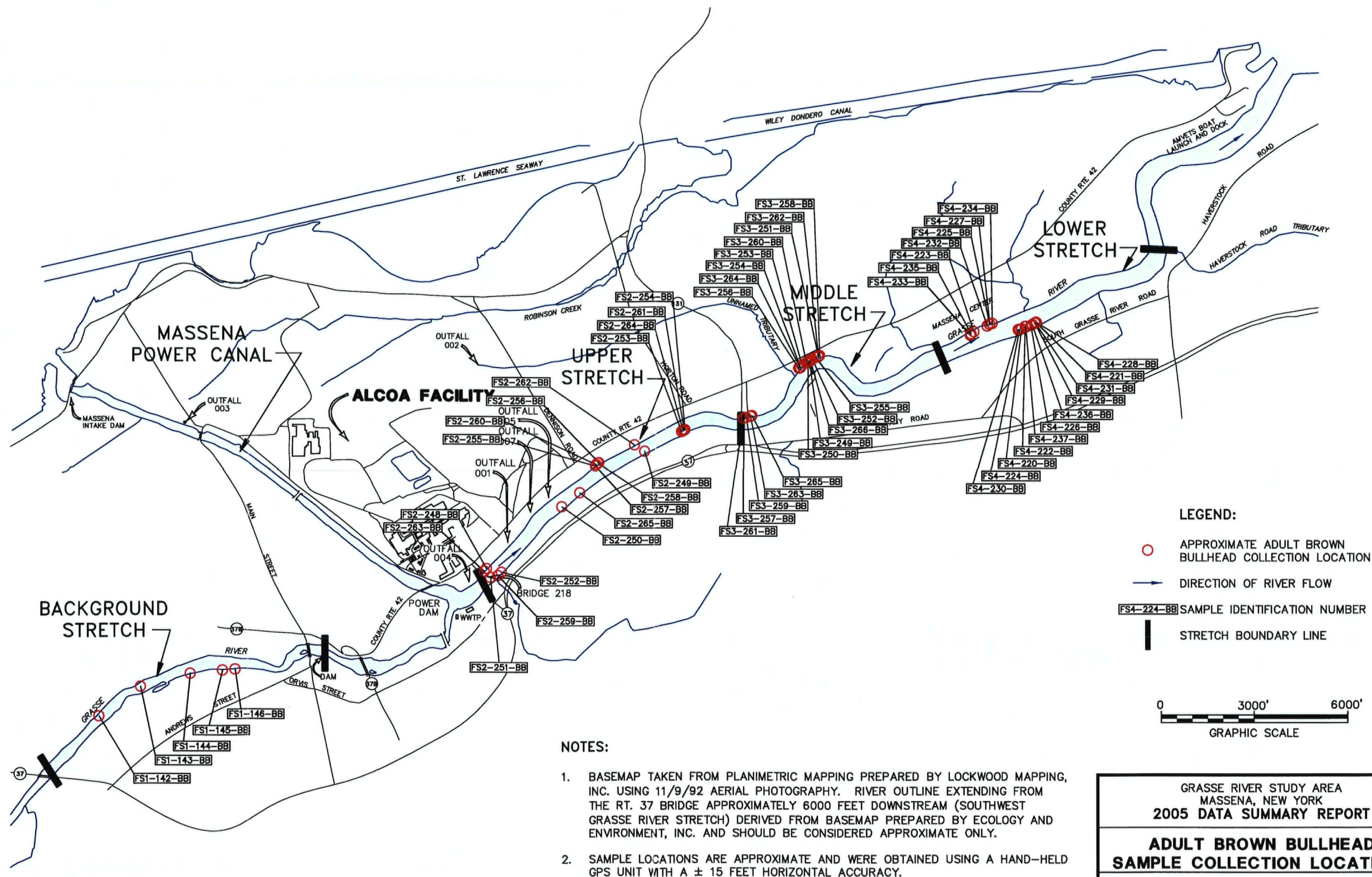
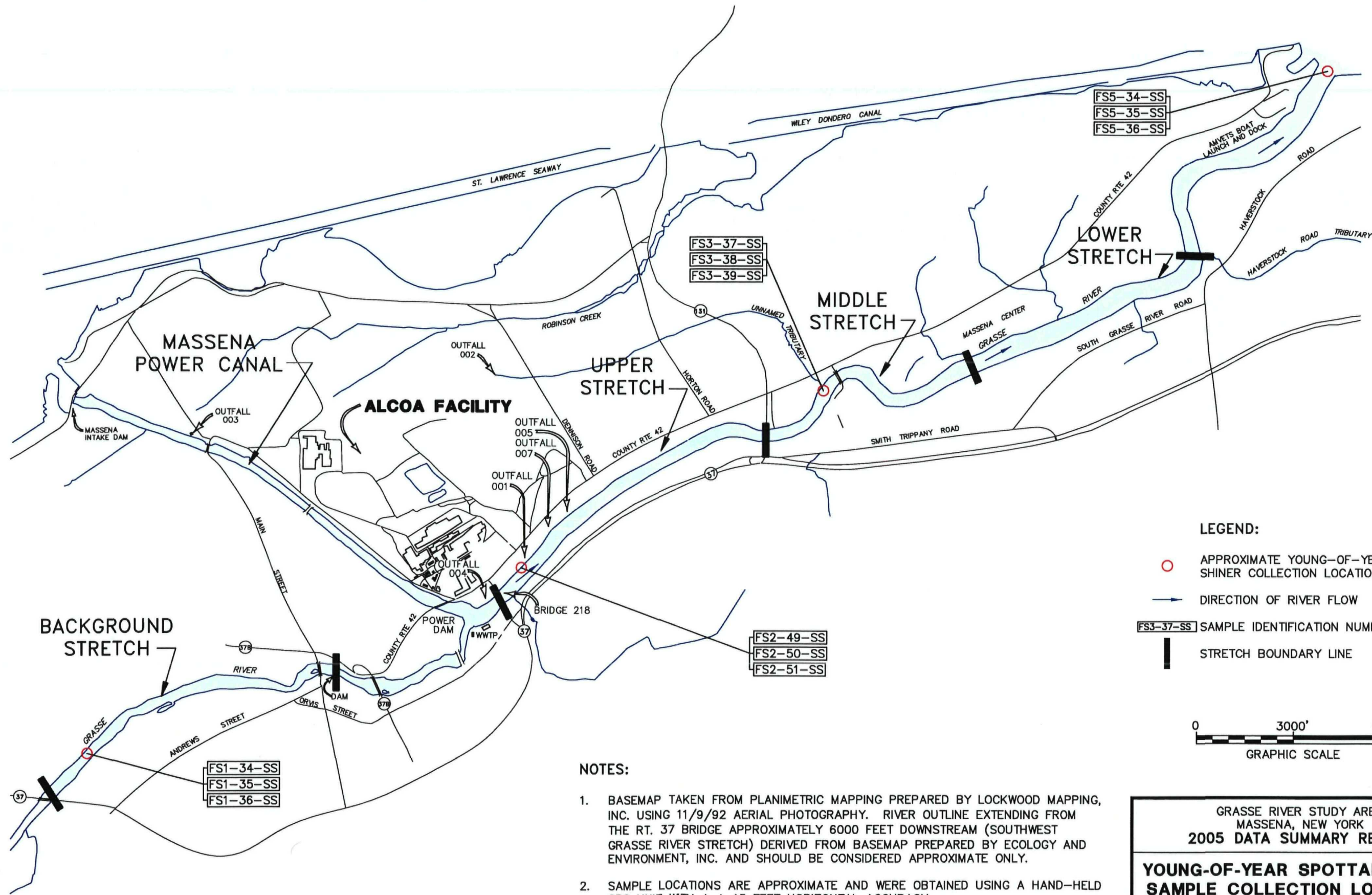

ALCOA

FIGURE
2-12

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PROJECTNAME: 10813X01
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10813X00
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SAVED: 7/24/2006 1:55 PM
IMAGES: 10813X01
10813X00





NOTES:

1. BASEMAP TAKEN FROM PLANIMETRIC MAPPING PREPARED BY LOCKWOOD MAPPING, INC. USING 11/9/92 AERIAL PHOTOGRAPHY. RIVER OUTLINE EXTENDING FROM THE RT. 37 BRIDGE APPROXIMATELY 6000 FEET DOWNSTREAM (SOUTHWEST GRASSE RIVER STRETCH) DERIVED FROM BASEMAP PREPARED BY ECOLOGY AND ENVIRONMENT, INC. AND SHOULD BE CONSIDERED APPROXIMATE ONLY.
2. SAMPLE LOCATIONS ARE APPROXIMATE AND WERE OBTAINED USING A HAND-HELD GPS UNIT WITH A ± 15 FEET HORIZONTAL ACCURACY.

LEGEND:

- APPROXIMATE YOUNG-OF-YEAR SPOTTAIL SHINER COLLECTION LOCATION
- DIRECTION OF RIVER FLOW
- FS3-37-SS SAMPLE IDENTIFICATION NUMBER
- STRETCH BOUNDARY LINE

0 3000' 6000'
 GRAPHIC SCALE

GRASSE RIVER STUDY AREA
 MASSENA, NEW YORK
 2005 DATA SUMMARY REPORT

**YOUNG-OF-YEAR SPOTTAIL SHINER
 SAMPLE COLLECTION LOCATIONS**



FIGURE
2-14

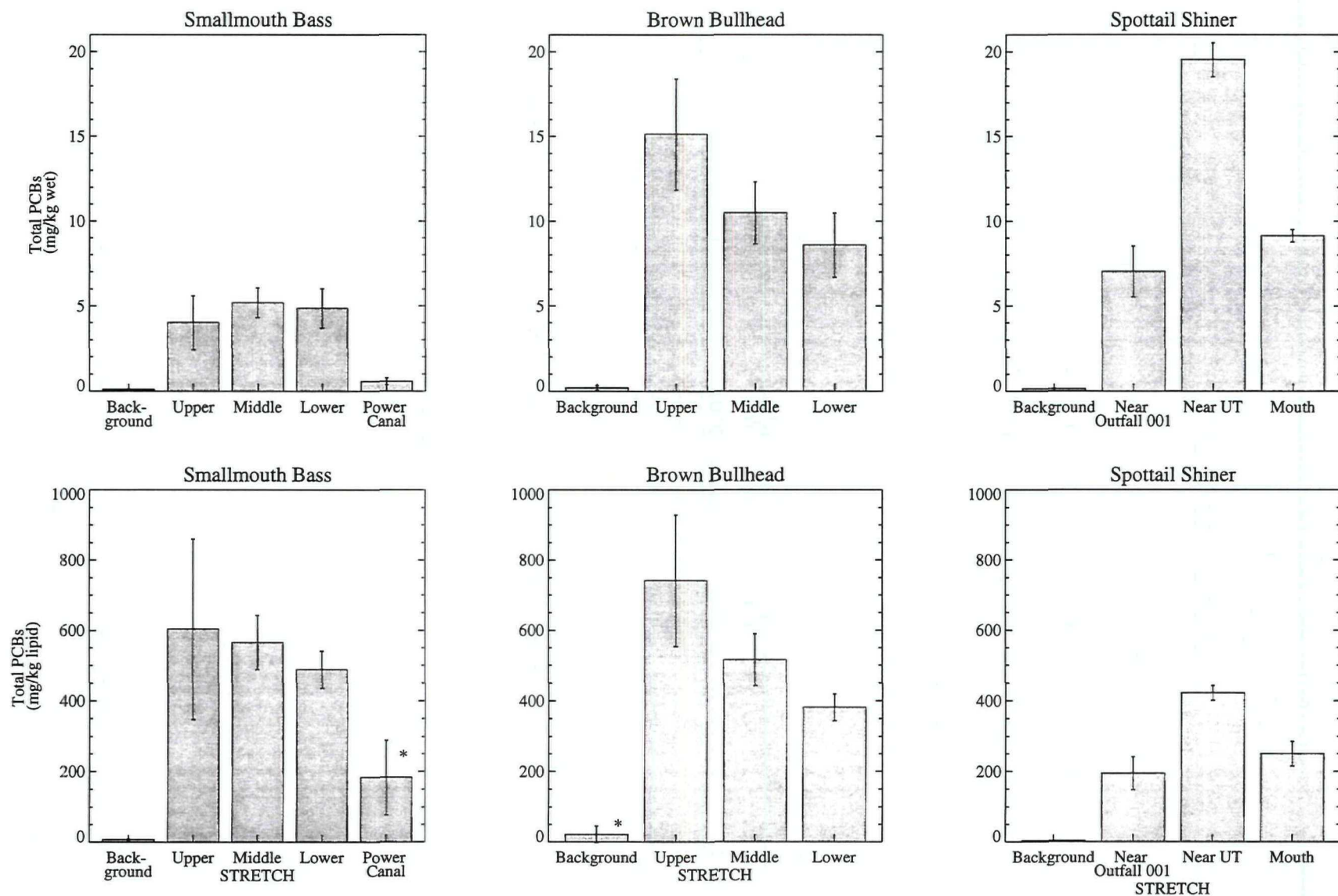


Figure 2-15. Average Aroclor-Based PCB Concentrations in Fish Collected in Fall 2005

Values represent arithmetic averages (+/- 2 standard errors). Non-detect values set to half the detection limit prior to averaging.

* One smallmouth bass and one brown bullhead sample were excluded due to unreasonably low lipid content (<0.1%).

Data table: resfish_aro

Routine Monitoring Stretches

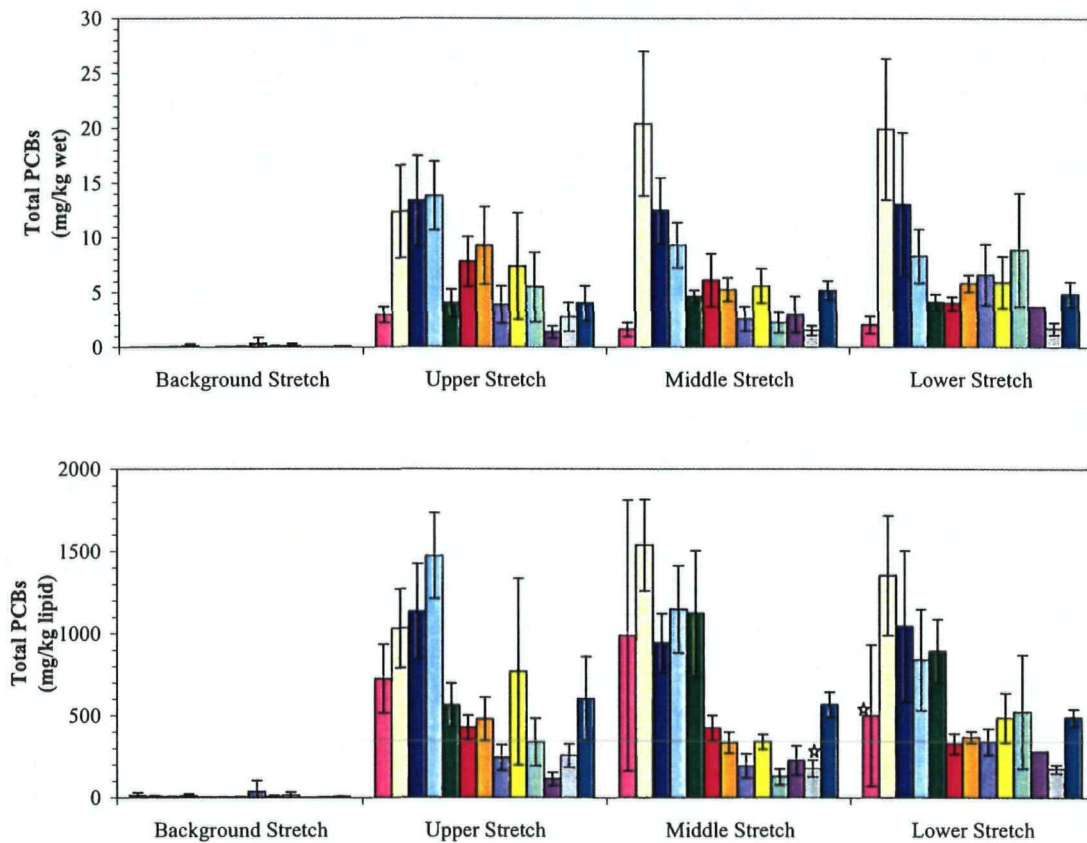


Figure 2-16. Average Aroclor-based PCB Levels in Smallmouth Bass (1991-2005)

Data are arithmetic means \pm two standard errors of the mean.

Samples analyzed as individual fillets.

Values below detection set to half the detection limit. If no detection limit reported, 0.05 ppm wet weight assumed.

Error bar not plotted if sample count fewer than three.

Analytical methods employed by the laboratories have changed over time and thus, may affect comparability of these results.

★ One 1991 and one 2004 sample were excluded due to unreasonably low lipid content ($<0.1\%$).

Data table: resfish_aro



Power Canal

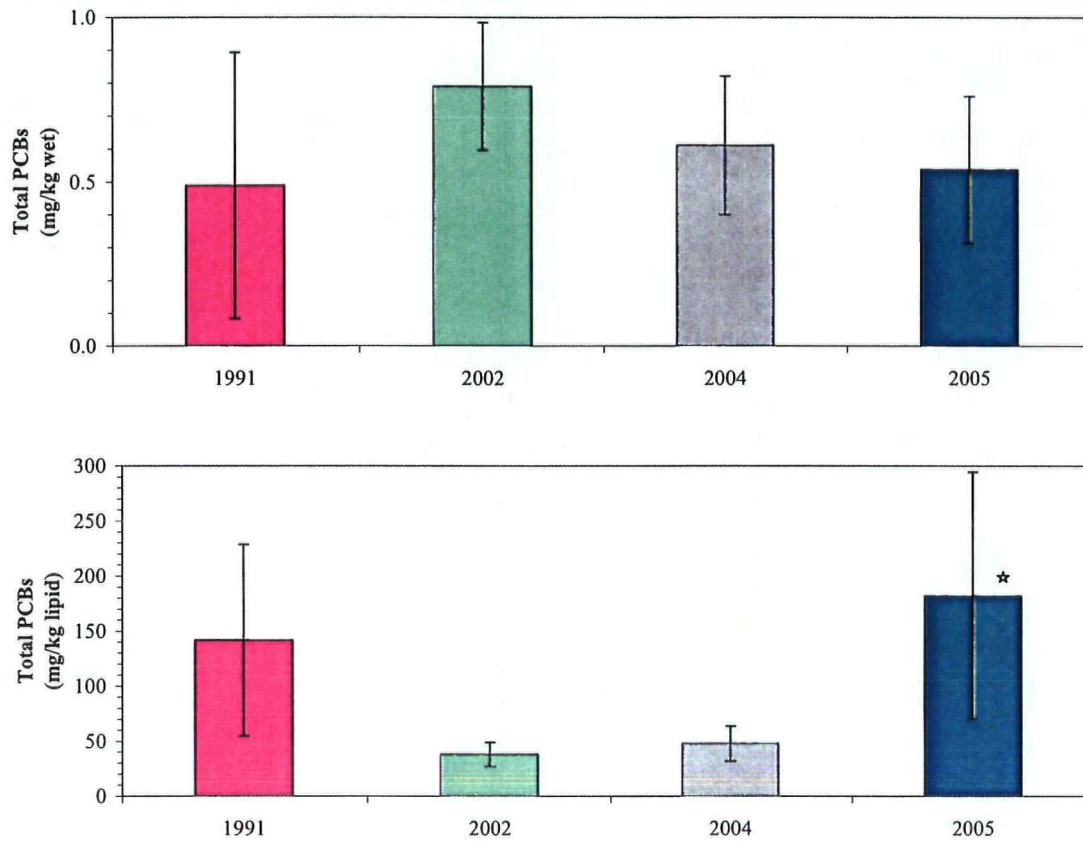


Figure 2-17. Average Aroclor-based PCB Levels in Smallmouth Bass from the Power Canal

Data are arithmetic means +/- two standard errors of the mean.

Samples analyzed as individual fillets.

Values below detection set to half the detection limit. If no detection limit reported, 0.05 ppm wet weight assumed.

Error bar not plotted if sample count fewer than three.

Analytical methods employed by the laboratories have changed between 1991 and 2002 and thus, may affect comparability of these results.

★ One sample from 2005 excluded due to unreasonably low lipid content of the sample (0.05%).

Data table: resfish_aro

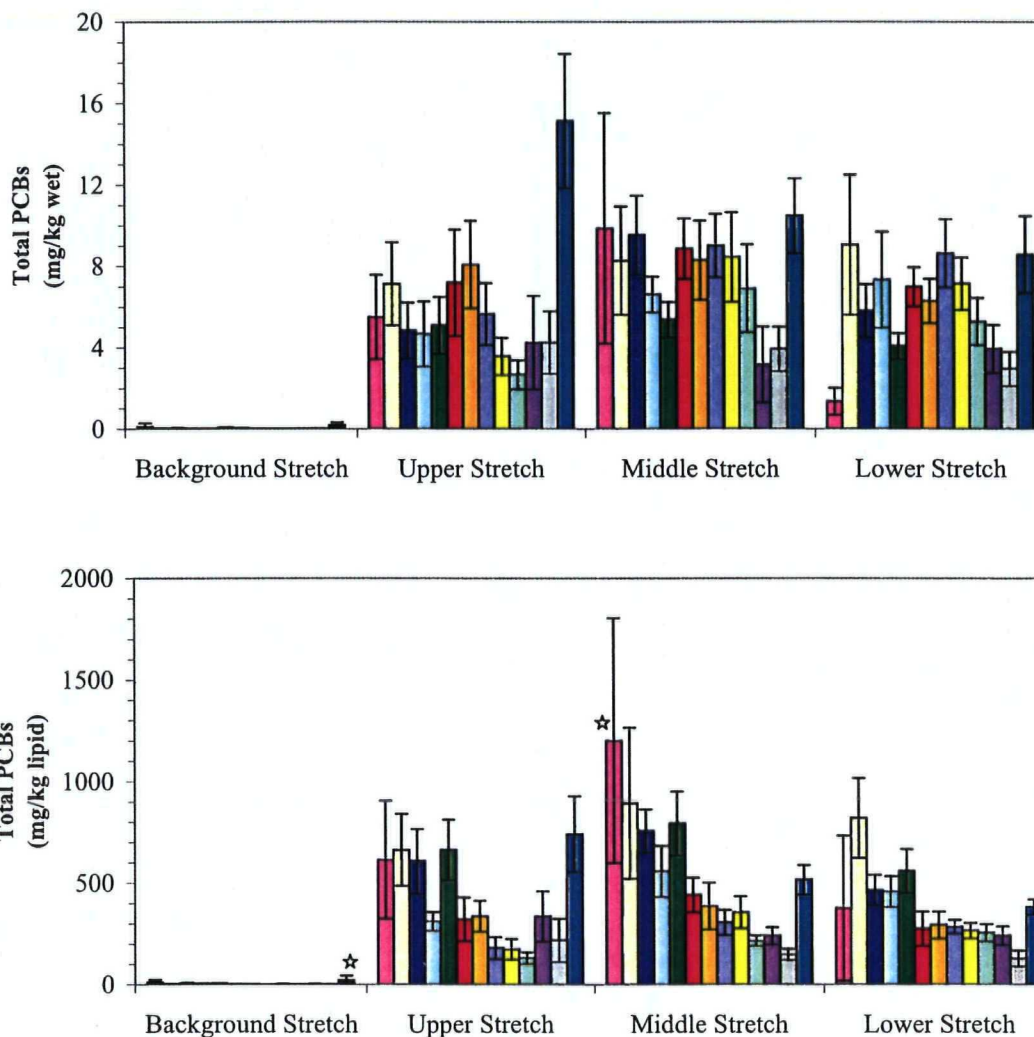


Figure 2-18. Average Aroclor-based PCB Levels in Brown Bullhead (1991-2005)

Data are arithmetic means \pm two standard errors of the mean.

Samples analyzed as individual filets.

Values below detection set to half the detection limit. If no detection limit reported,

0.05 ppm wet weight assumed.

Error bar not plotted if sample count fewer than three.

Analytical methods employed by the laboratories have changed over time and thus, may

affect comparability of these results.

★ *One 1991 and one 2005 sample were excluded due to unreasonably low lipid content ($<0.1\%$).*

Data table: resfish_aro



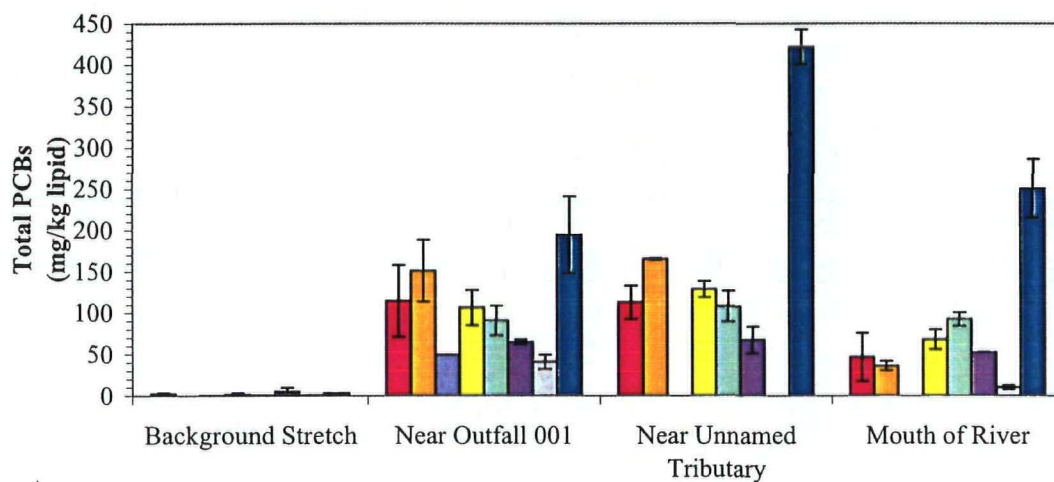
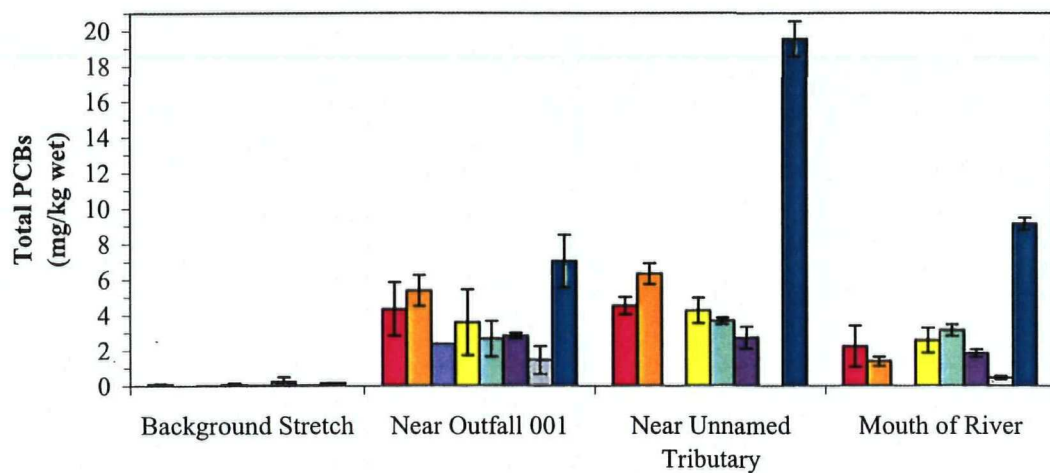


Figure 2-19. Average Aroclor-based PCB Levels in Young-of-Year Spottail Shiner (1998-2005)

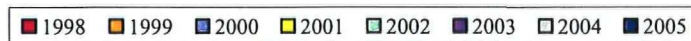
Data are arithmetic means \pm two standard errors of the mean; error bar not plotted if sample count fewer than three.

Samples analyzed as whole body composites. Composite was considered as YOY if all individual lengths were less than 6.5 cm.

Values below detection set to half the detection limit. If no detection limit reported, 0.05 ppm wet weight assumed.

Analytical methods employed by the laboratories have changed over time and thus, may affect comparability of these results.

Data table: resfish_aro



Section 3

SECTION 3 2005 FOCUSED STUDY

3.1 TSS MONITORING DURING SPRING HIGH FLOW/ICE BREAKUP

3.1.1 Collection Summary

TSS sampling was conducted from the Main Street (WCMSB) and Alcoa Bridges (WCAB) from March 31 through April 3, 2005 (see **Figure 3-1** for sample locations). Twelve grab samples were collected each from the Main Street and Alcoa Bridges prior to and during the rising limb of the hydrograph. The sampling frequency outlined in the 2005 Monitoring Work Plan (Alcoa, March 2005) (i.e., hourly sampling during the rising limb of the hydrograph and once every two hours on the falling limb of the hydrograph) could not be achieved due to safety concerns and logistical challenges. However, sampling was conducted up to six times per day, as conditions permitted, with emphasis on the time period when ice was clearing and moving through the lower river. Water column samples were generally collected mid-channel at approximately 0.5 times the total water column depth at each location.

A total of 24 samples (not including QA/QC samples) were packaged and submitted to the Alcoa Massena ChemLab (ChemLab) in Massena, NY for TSS analysis consistent with the methodologies outlined in the 2005 Monitoring Work Plan (Alcoa, March 2005). QA/QC samples were collected as planned (one duplicate TSS sample per 20 field samples during a mobilization or a minimum of one per mobilization).

3.1.2 Results

3.1.2.1 Stage Height and Flow Data

Provisional stage height and flow data for the USGS gaging station at Chase Mills (# 04265432) were downloaded for the period of interest from the USGS website

[http://waterdata.usgs.gov/nwis/uv/?site_no=04265432]. Stage height and flow are measured every 15 minutes at this station, located approximately 11 miles upstream of the Main Street Bridge (WCMSB). Stage height data are also automatically measured and recorded at Alcoa Outfall 001 (**Figure 3-1**) throughout the year, and downloaded by the ChemLab for data storage. The stage height data for both Chase Mills and Outfall 001 gages, and the flow for Chase Mills, are presented in **Figure 3-2** for the March 31 through April 4, 2006 timeframe.

It should be noted that the USGS does not report flow data for the Chase Mills station during periods of ice cover, due to potential inaccuracies associated with ice-related backwater. For the winter of 2004/05, flow data from the Chase Mills gage stopped on December 15, 2004 and resumed at midnight on March 31, 2005, after ice had cleared from that portion of the river. Stage height data continued to be reported by USGS at Chase Mills throughout the winter, but their accuracy could be affected by the presence of ice (Phillips, April 2004).

3.1.2.2 Monitoring Results

TSS and river flow data for the sampling period are presented in **Table 3-1**. These data are plotted with respect to time, and in relation to stage height and flow on **Figure 3-2**. Similar temporal patterns were observed for all three parameters. Stage height (at Outfall 001) increased from about 5.5 ft. on April 1, peaked at 8.2 ft. on the April 3, and then returned to about 5.6 ft. on the April 4 (**Figure 3-2, top panel**). Between March 31 and April 4, instantaneous river flows increased from about 3,800 to 8,500 cfs and then declined to 7,800 cfs by end of day on April 4 (**Figure 3-2, middle panel**). TSS levels measured from the Main Street Bridge increased from 22 to 150 mg/L from March 31 to April 3 and then declined to approximately 68 mg/L late in the day on April 3 (**Figure 3-2, bottom panel**). At the Alcoa Bridge, TSS levels increased from 21 to 104 mg/L from March 31 to April 3, before decreasing to 59.2 mg/L in the last sample collected at 4:20 p.m. on April 3.

As expected, TSS levels increased as a function of stage height (**Figure 3-3**). The TSS concentrations at the Main Street and Alcoa Bridges were generally below 30 mg/L at a stage height of 6.0 ft. at the Outfall 001 gage; the levels increased to over 60 mg/L at a stage height of

8.0 ft. Similarly, TSS concentrations increased from below 30 mg/L at a stage height of 6.2 ft., to above 50 mg/L at a stage height of about 6.9 ft. at the Chase Mills gage.

3.1.2.3 Comparison to Historic Data

Data from March/April 2005 are compared to historic TSS measurements from the Main Street Bridge on **Figure 3-4**. TSS concentrations measured on the rising limb of the hydrograph in March/April 2005 (red diamonds) were generally higher than TSS levels measured previously from the river (under similar flow conditions) and several times higher than would be estimated using the rating curve that was previously developed for the Grasse River based on 1997/98 data (Alcoa, April 2001) (**Figure 3-4**). The rating curve will be updated with TSS and flow data collected during spring high flow/ice breakup monitoring in 2004 and 2005 to account for the greater concentrations of solids that enter the river during the spring high flow periods.

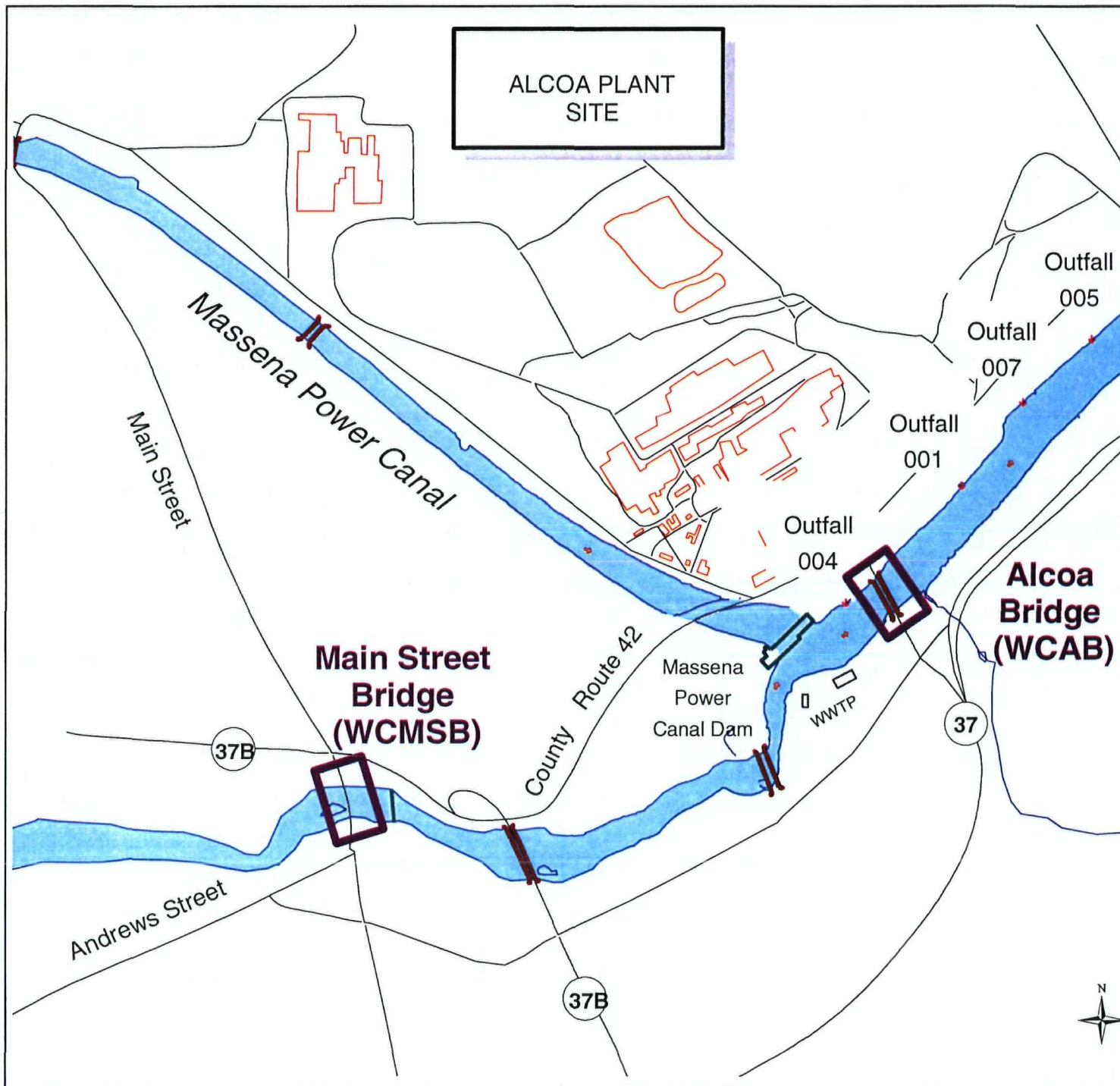
**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**Table 3-1
TSS Data Collected During 2005 High Flow
Sampling at the Main Street and Alcoa Bridges**

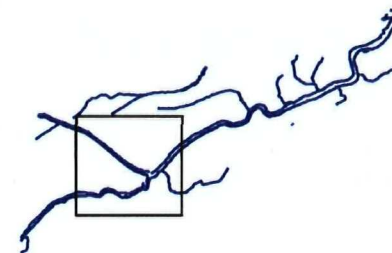
| Date | Time | Approx. Flow ^{1,2} (cfs) | Location Along Bridge ³ | TSS ⁴ (mg/L) |
|---------------------------|-------|--------------------------------------|---------------------------------------|-------------------------|
| <i>Main Street Bridge</i> | | | | |
| 3/31/2005 | 12:45 | 4360 | M | 22.4 |
| 3/31/2005 | 16:20 | 3970 | M | 28.0 |
| 4/1/2005 | 10:40 | 4770 | M | 30.0 |
| 4/1/2005 | 15:55 | 4880 | M | 51.6 |
| 4/2/2005 | 5:30 | 4990 | M | 26.0 (24.0) |
| 4/2/2005 | 13:20 | 4920 | M | 31.6 |
| 4/3/2005 | 9:30 | 7110 | M | 53.6 (52.8) |
| 4/3/2005 | 10:30 | 7330 | M | 58.8 |
| 4/3/2005 | 11:30 | 7420 | M | 58.0 |
| 4/3/2005 | 13:30 | 7560 | M | 150.4 |
| 4/3/2005 | 14:50 | 7700 | M | 88.4 |
| 4/3/2005 | 16:10 | 7840 | M | 67.6 |
| <i>Alcoa Bridge</i> | | | | |
| 3/31/2005 | 12:50 | 4360 | L | 19.6 (22.4) |
| 3/31/2005 | 16:45 | 3910 | L | 26.4 |
| 4/1/2005 | 10:25 | 4690 | L | 23.2 (26.4) |
| 4/1/2005 | 15:40 | 4770 | L | 32.4 |
| 4/2/2005 | 5:15 | 5070 | M | 24.4 |
| 4/2/2005 | 13:40 | 4800 | M | 29.2 |
| 4/3/2005 | 9:45 | 7380 | M | 45.2 |
| 4/3/2005 | 10:45 | 7330 | M | 53.6 |
| 4/3/2005 | 11:46 | 7520 | M | 50.0 |
| 4/3/2005 | 14:00 | 7420 | M | 104.0 |
| 4/3/2005 | 15:05 | 7470 | M | 82.8 |
| 4/3/2005 | 16:20 | 7840 | M | 59.2 |

Notes:

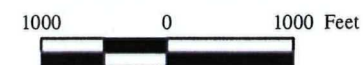
- Flow data are recorded in 15 minute intervals at the USGS gage on the Grasse River at Chase Mills and were downloaded from the USGS website.
- Flow data shown are approximated to the value at the nearest 15 minute interval.
- M = middle of bridge, L = left side of bridge looking downstream
cfs = cubic feet per second, TSS = total suspended solids, mg/L = milligrams per liter
- Results for duplicate samples are in parentheses.



LOCATOR MAP



GRAPHIC SCALE



LEGEND

- River Flow Direction Arrows
- Roads
- Wastewater Treatment Plant
- Alcoa Buildings
- Bridges
- Dams
- Grasse River + Tributaries Shoreline

Lower Grasse River Study Area Massena, New York

Figure 3-1.
Water Column Sampling Locations
in March/April 2005 (TSS Sampling)



April 2004

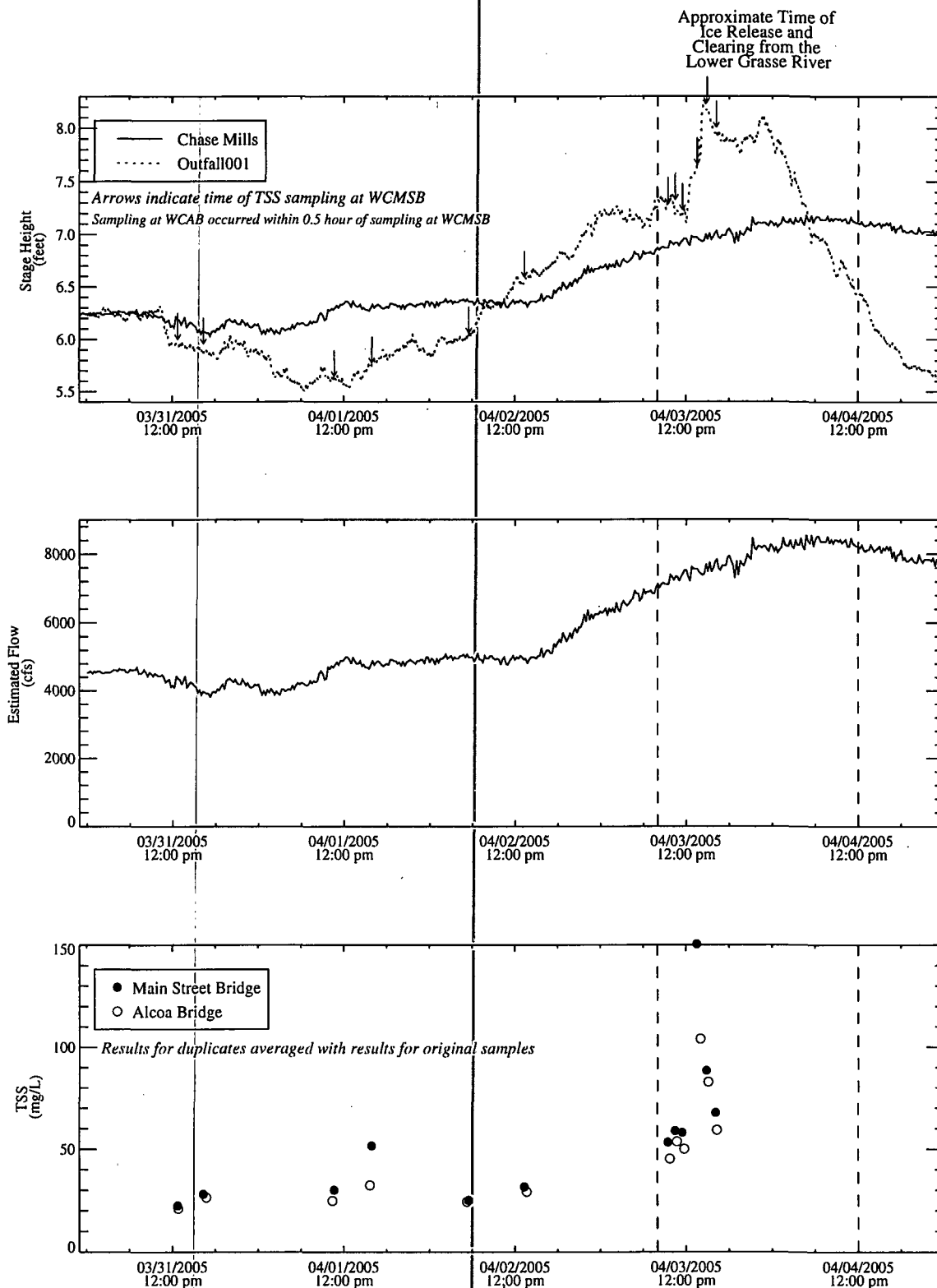


Figure 3-2. Stage Height, Flow, and Total Suspended Solids From March 31 - April 4, 2005

Grasse River stage height and flow recorded every 15 minutes at the USGS Chase Mills gage (#04265432).

Flows before 3/31/05 were not reported due to ice at this location.

Stage height also measured every 5 minutes using a staff gage adjacent to Outfall 001.

Grab samples for TSS analysis were collected at mid-depth.

Data tables: riverflow_ChaseMills, riverflow_trans, water_field

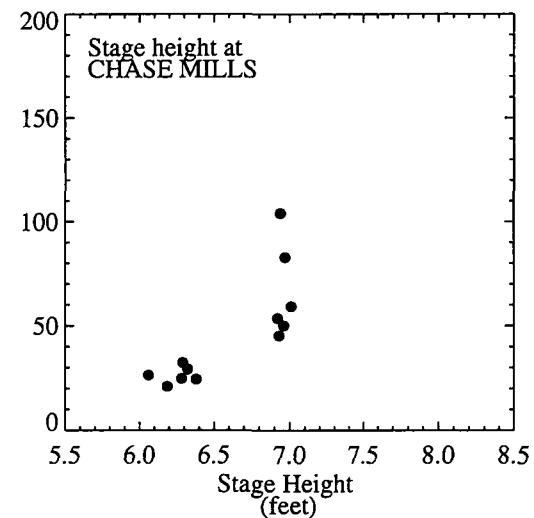
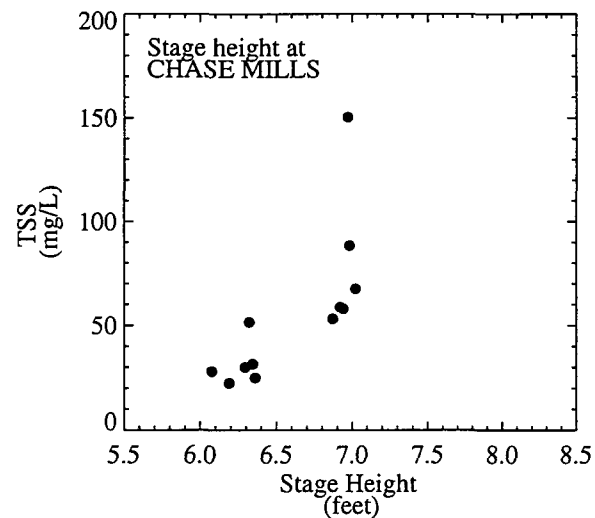
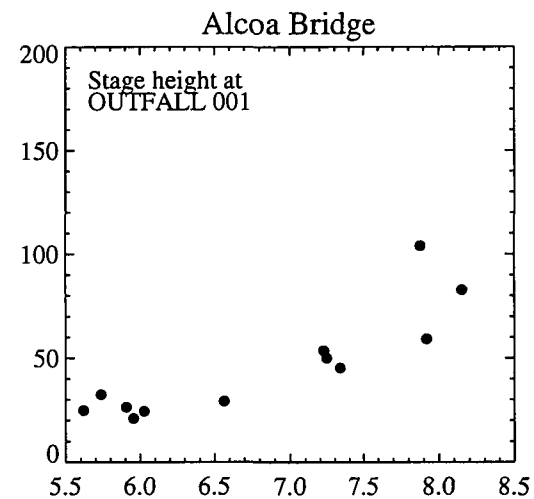
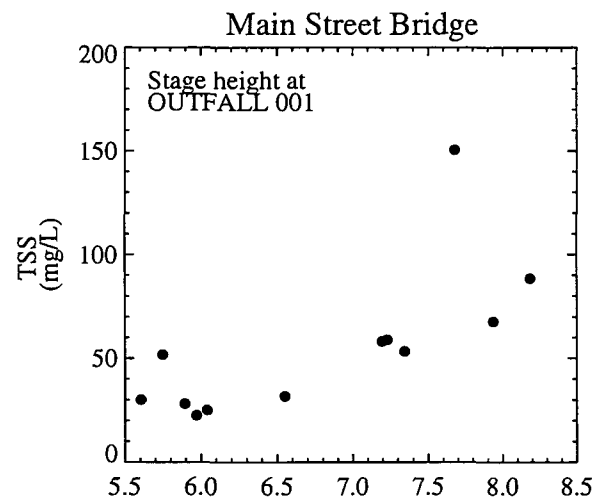


Figure 3-3. Water Column TSS Concentrations Versus Stage Height (March 31 - April 3, 2005)

TSS results for duplicates averaged with results for original samples; TSS measurements made on the rising limb of the hydrograph. Grasse River stage height measured every 5 minutes at Outfall 001 and every 15 minutes at USGS Chase Mills gage (#04265432).

Data tables: riverflow_ChaseMills, riverflow_trans, water_field

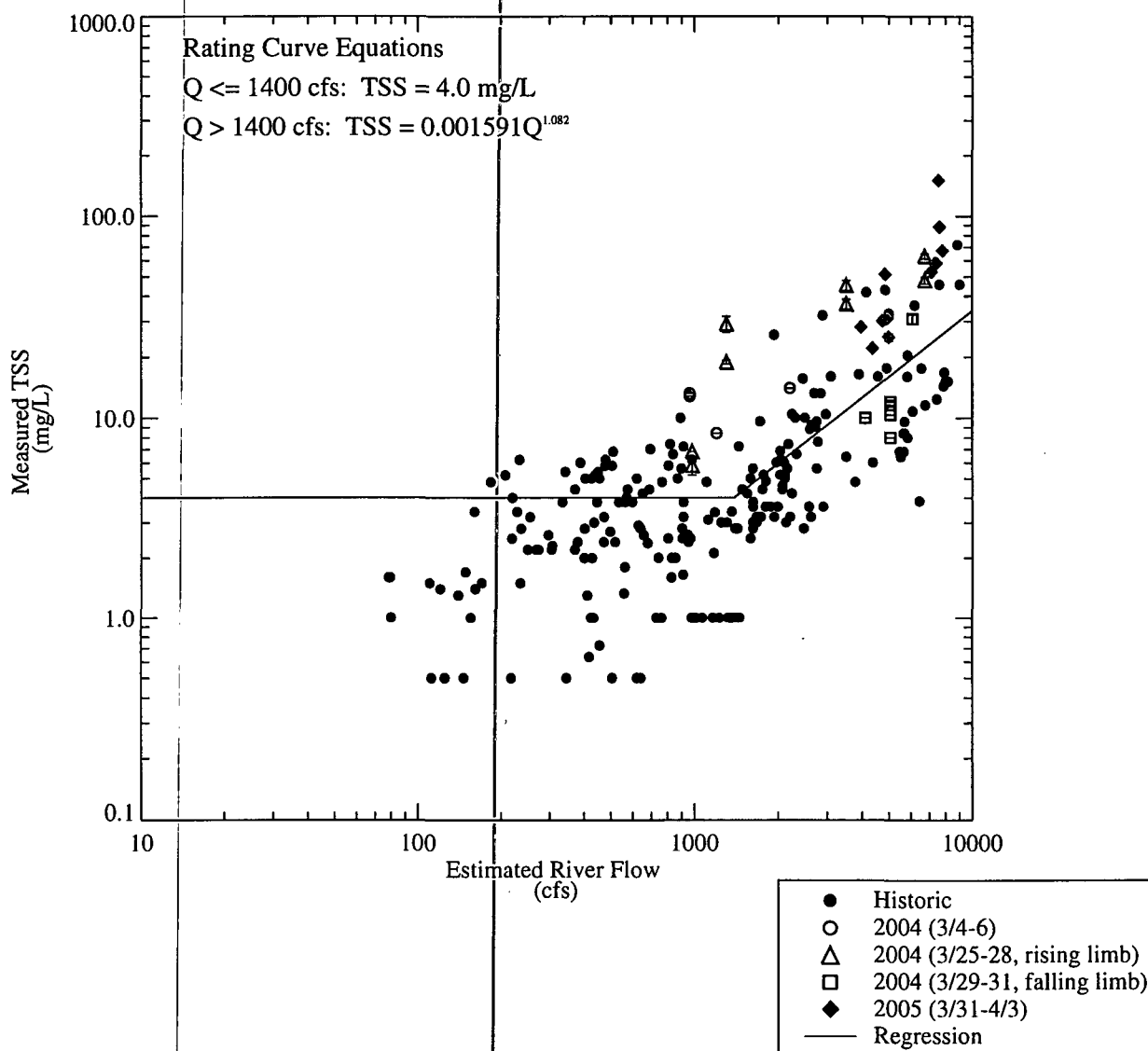


Figure 3-4. Solids Concentrations Measured at the Main Street Bridge / WC001 as a Function of River Flow

Mean +/- range shown for TSS data collected at same time during 2004 and 2005; historic data from 1997 through 2003.

Flows based on site-specific data (transducer or tapedown) when available; when site-specific data not available, flows estimated from USGS records on the Oswegatchie River or on the Grasse River at Chase Mills.

Rating curve was generated from 1997 and 1998 data; non-detect concentrations set to half the detection limit.

Data tables: riverflow_hist, riverflow_tape, riverflow_trans, riverflow_ChaseMills, water_field

SECTION 4 QUALITY ASSURANCE/QUALITY CONTROL

4.1 INTRODUCTION

This appendix describes the quality control evaluation conducted for the water column and resident fish data collected from the lower Grasse River in 2005 as part of the SRS Program and Focused Study. Guidelines set forth in the *2005 Monitoring Work Plan* (Alcoa, March 2005) were supplemented, where appropriate, with those discussed in the Quality Assurance Project Plan (QAPP) developed for the Grasse River project (Blasland, Bouck & Lee, Inc. [BBL], September 1993). These guidelines were established to assess whether field, laboratory, and data management activities were performed in a manner that is appropriate for accomplishing the project objectives.

The procedures and metrics used in the QA/QC evaluation are presented in Section 4.2, while the results of the data evaluation are discussed in Section 4.3.

4.2 QA/QC PROCEDURES

The QA/QC procedures used to evaluate the data collected during 2005 consisted of several steps, including:

- review of the field chain-of-custody (COC) forms and data received from the laboratory for completeness;
- automation of data compilation, when possible, to minimize errors within the database; and
- review of the QA/QC data to assure that results of the quality control analyses are within the control limits developed for the project.

Upon receipt of the data, the field COC forms were reviewed and compared to the data received from the laboratory to ensure that sample identifications listed on the COC forms matched those reported in the data packages. This process was used to check that results were reported for all field and QA/QC samples (such as MS and MSD).

Following this review, the data were compiled and entered into an Excel database. All data from the laboratory were received electronically and appended, when possible, to the existing database using tools available in Excel. During the rare occasions when tools could not be used (i.e. data arrived in portable document format [PDF]), data were manually inputted into the databases.

After the data were incorporated into the project database, several metrics (as outlined in the QAPP) were evaluated to determine the quality of the water column and resident fish data. Data metrics used in this evaluation included:

- overall data completeness;
- method detection limits (MDL);
- number of QA/QC samples collected and analyzed;
- blank analysis;
- MS and MSD analyses; and
- field duplicate analysis.

Data were deemed acceptable if the following criteria were satisfied:

- Overall data completeness equaled or exceeded 90%. Overall data completeness was computed by dividing the number of valid data obtained by the total number of data planned for collection and analyses.
- MDLs from the QAPP for total PCBs quantified on an Aroclor basis in water and biota samples were about 65 ng/L and 0.05 mg/kg, respectively. MDLs for total PCB congeners were not specified. The MDL for TSS in water was 1.0 mg/L.

- For the routine water column samples, a minimum of one equipment rinse blank was collected before and after sampling. In addition, at least one duplicate sample and one MS/MSD pair were collected each month.
- For resident fish samples, a minimum of one MS/MSD pair was collected per twenty field samples.
- PCB levels in laboratory, equipment (rinse), and method blanks were near or below the detection limit.
- Percent recoveries for MS/MSD samples analyzed for total PCBs were between 70% and 130% (to evaluate accuracy).
- The relative percent difference between MS and MSD samples analyzed for total PCBs were less than 35% (to evaluate precision).
- Criteria for relative percent differences between field samples and their duplicates analyzed for total PCBs or TSS were not prescribed in the QAPP.

Data that did not comply with the guidelines outlined above are documented in Section 4.3.

4.3 RESULTS OF QA/QC ANALYSES

This section presents the results of the QA/QC analyses performed on the 2005 data. A discussion of the water column and resident fish data is provided below.

4.3.1 Water Column

This subsection reports the assessment of QA/QC data collected during the routine water monitoring program and the monitoring of TSS during spring high flow/ice breakup.

Completeness. Samples (one bottle for PCB analysis and one bottle for TSS analysis at each sampling transect) were collected as planned⁶ for all seven transects during the 15 rounds of routine monitoring in 2005. However, one bottle (collected at 0.2 times the total water column depth at WCT11 on 7/27/05) intended for PCB analysis arrived broken at the lab. Instead, the bottle planned for TSS analysis from the same location was analyzed for total PCBs and therefore, no sample was available for TSS analysis.

As per the 2005 Monitoring Work Plan, TSS samples were collected as conditions allowed during the rising limb of the hydrograph during the spring high flow/ice breakup. TSS sampling during the falling limb of the hydrograph was not conducted as planned due to safety and logistical challenges.

Method detection limit. Since a MDL was not prescribed for PCB congeners, the MDL for Aroclors was used for comparison. The lower bound estimate of the nominal MDL for routine monitoring water samples was about 27.8 ng/L for total PCBs (Alcoa, April 2002), below the QAPP requirement of 65 ng/L.

The MDL for TSS measured as part of routine monitoring met the requirement of 1.0 mg/L. For the TSS measurements during spring high flow/ice breakup, the MDL of 1.43 mg/L exceeded the requirement; however, results for all field samples during this study were greater than 13 times the MDL.

Number of QA/QC samples. The number of field duplicates and MS/MSD samples met the requirement of 15 each. The number of rinse blanks collected met the requirement of 30, but only 29 were analyzed as one sample arrived broken at the lab. Additional QA/QC samples for PCBs included 15 laboratory blanks and 15 laboratory control spikes.

⁶ During Round 13 (9/21/05-9/22/05), the following PCB congener samples were found to be broken upon arrival at the laboratory: WC-MSB-13(0.5), WC131-13(0.8), and WC-05-13 (duplicate). The laboratory analyzed the TSS samples for PCB congeners, and the TSS samples from these locations were re-collected in the field on 9/22/05 and analyzed.

The requirement of one field duplicate per sampling round for TSS analysis was fulfilled for routine monitoring. For the TSS measurements during spring high flow/ice breakup, the requirement of one duplicate TSS sample per 20 field samples during a mobilization or a minimum of one per mobilization was met.

Blanks. All blank concentrations were near or below the nominal detection limit. Reported PCB levels in rinse blanks ranged from 0.0⁷ to 14.4 ng/L, with one exception of 23.7 ng/L. Laboratory blank concentrations ranged from 0.0 to 1.9 ng/L, with one exception of 13.1 ng/L.

Matrix spike and matrix spike duplicates. One of the 15 MS/MSD pairs was not within the prescribed range for MS percent recovery and relative percent difference; this sample had a MS percent recovery of 63.0% and RPD of 40.9% (see Table 4-1).

Field duplicates. For the routine monitoring, the relative percent difference between the fifteen pairs of samples and their duplicates analyzed for total PCBs and for TSS ranged from 2.3% to 200% and 3.8% to 81.5%, respectively. For the spring high flow/ice breakup TSS monitoring, the RPD between the four pairs of samples and their duplicates ranged from 8.0% to 13.3%. Criteria for the relative percent differences between samples and their duplicates analyzed for total PCBs and for TSS were not defined in the QAPP.

4.3.2 Resident Fish

This subsection reports the assessment of QA/QC data collected during the resident fish monitoring program. Since the ROPS was on-going during the time of fish collection, this assessment can also be found in the draft ROPS Documentation Report (Alcoa, May 2006).

⁷ The concentrations of all PCB congeners were reported as non-detect (less than the per congener MDL of 0.2 ng/L). The total PCB concentration reported by the laboratory is the sum of all congener concentrations above the MDL.

Completeness. All samples were collected as stated in the 2005 Work Plan (Alcoa, March 2005). A total of 144 samples were submitted to the laboratory for PCB and lipid analysis. No samples were lost during shipment or analysis.

Method detection limit. Five of the 144 samples submitted to the laboratory had PCB levels that were reported below the detection limit. All samples were analyzed at the 0.05 mg/kg wet weight MDL defined in the QAPP, with the exception of one sample that was analyzed at a detection limit of 0.18 mg/kg. It should be noted that samples were reported as non-detect by the laboratory if their concentrations were less than the practical quantitation limit (PQL).

Number of QA/QC samples. Eight MS/MSD pairs were extracted, analyzed, and reported by the laboratory, meeting the requirement of seven pairs. In addition, eleven method blanks and eleven laboratory control spikes were included for analysis.

Blanks. All method blanks contained non-detectable PCB levels.

Matrix spike and matrix spike duplicates. All MS/MSD sample pairs had relative percent differences within prescribed limits. One MS sample had a percent recovery of 67%, falling outside the prescribed limits (see **Table 4-1**).

Field duplicates. The collection of field duplicates was not performed as part of the resident fish sampling program.

4.4 SUMMARY

In general, the quality of the data for water column and resident fish samples collected during 2005 met the guidelines established for the project. On the infrequent occasions when guidelines were not met, the affected samples are identified in the database as appropriate. As a result of the QA/QC evaluation, all data that were collected were deemed appropriate for use in performing qualitative and quantitative evaluations required to satisfy the project objectives.

GRASSE RIVER STUDY AREA
Massena, New York

Table 4-1
Data from 2005 SRS Program
Individual Samples Not Meeting QA/QC Guidelines

| Media | Analyte | Sample Date | Location (depth) | Result | | % Recovery | | Relative % Difference | | Reason for Non-Compliance |
|---------------|----------------|-------------|----------------------|--------------|-----------------|--------------|-------|-----------------------|--------------|--|
| | | | | Field Sample | Field Duplicate | MS | MSD | Field Duplicate | MS/MSD | |
| Water | PCB (Congener) | 6/16/05 | WC-T11 (0.8) | 1321.8 | --- | 63.00 | 95.40 | --- | 40.91 | MS falls outside %R limit; MS/MSD falls outside %RPD |
| Resident Fish | PCB (Aroclor) | 8/30/05 | Upper/ Sm Mouth Bass | 12.00 | --- | 66.90 | 76.00 | --- | 14.40 | MS falls outside %R limits |

Notes:

1. Units: PCB (water) = nanograms/liter; PCB (Fish) = micrograms/gram
2. QA/QC - Quality Assurance/Quality Control; MS - matrix spike; MSD - matrix spike duplicate; %R - Percent Recovery; PCB - polychlorinated biphenyl
3. Criteria listed in QAPP (BBL, September 1993): MS/MSD %R should be between 70 and 130%, %RPD should be less than 35%, Surrogate %R should be between 60 and 150%.
4. Bold and italicized numbers indicate where samples did not meet criteria.
5. %RPD of MS/MSD sample based on percent recoveries.
6. %RPD of field duplicate sample based on sample concentrations.
7. $\%RPD = |(A-B)| / ((A+B)/2) * 100$
8. --- Not applicable.

SECTION 5 REFERENCES

- Alcoa, April 2001. *Comprehensive Characterization of the Lower Grasse River.*
- Alcoa, April 2002. *2001 Supplemental Remedial Studies Program: Summary Report.*
- Alcoa, January 2005. *2004/2005 Grasse River Ice Monitoring Work Plan.*
- Alcoa, February 2005. *Remedial Options Pilot Study Work Plan.*
- Alcoa, March 2005. *2005 Monitoring Work Plan.*
- Alcoa, December 2005. *2005/2006 Grasse River Ice Monitoring Work Plan.*
- Alcoa, April 2006. *Technical Memorandum -- Grasse River Project 2004/2005 River Ice Monitoring Documentation Summary.*
- Alcoa, May 2006. *Draft ROPS Documentation Report.*
- BBL, September 1993. *River and Sediment Investigation (RSI) Phase II Site Operations Plan, Grasse River Site, Massena, New York.*
- Phillips, M., 2004. *Personal Communication with United States Geological Survey.* April 23, 2004.

Appendix A

APPENDIX A

This Appendix contains the Grasse River Project Database. This database is provided electronically on the enclosed CD. A data dictionary is also included to facilitate use of the database.

ELECTRONIC RECORD TARGET SHEET

| | |
|-------------------|------------------------|
| SITE NAME: | ALCOA AGGRAGATION SITE |
|-------------------|------------------------|

| | |
|--------------------|--------------|
| CERCLIS ID: | NYD980506232 |
|--------------------|--------------|

| | |
|---------------------|--------|
| SDMS DOC ID: | 113227 |
|---------------------|--------|

| | |
|-------------------------|----|
| ALT. MEDIA TYPE: | CD |
|-------------------------|----|

| | |
|-------------------------|----------------------|
| DOCUMENT FORMAT: | MDB and ArcView v3.1 |
|-------------------------|----------------------|

| | |
|---|---|
| NATIVE FORMAT LOCATION/FILENAME: | APPENDIX A_GIS DATABASE D:\customized_project D:\data_tables D:\shapefiles |
|---|---|

| | |
|------------------|---|
| COMMENTS: | CD CAN BE VIEWED IN THE SUPERFUND RECORDS CENTER, 290 BROADWAY, NYC SOME FILES ON THE CD ARE NOT A SUPPORTED FILE TYPE |
|------------------|---|

TABLES

- Table 1-1. List of updates included in version 6.0.
- Table 2-1. Directory structure for GIS CD-ROM.
- Table 2-2. List of shapefiles on the CD-ROM.
- Table 3-1. List of views in customized project.

FIGURES

- Figure 2-1. SQL connect window.
- Figure 3-1. Example view in customized project.
- Figure 3-2. Example of a select polygon for the 'Statistics by Polygon' tool.
- Figure 3-3. Example windows for the 'Statistics by Polygon' tool where user is queried for related table (a) and the field on which to perform the sub-selection of data for analysis (b).
- Figure 3-4. Example windows for the 'Statistics by Polygon' tool where user is queried on the criteria for sub-selection (a) and the field on which to perform the calculation (b).
- Figure 3-5. Final window displaying results of the 'Statistics by Polygon' macro.

START UP INSTRUCTIONS

Prior to viewing the Grasse River Project GIS Database, the user must perform the following tasks:

- mirror the drive letter of their CD drive to 'X'; and
- add an open database connectivity interface (ODBC) Access driver.

Mirroring the letter of your CD drive to X may be done whenever the computer is rebooted.

The ODBC Access Driver comes with Microsoft Office. If this driver has not been installed during setup, you will have to install it from the MS Office software. Note that the ODBC driver only has to be added once.

Change the drive letter of CD drive to X

1. Have ArcView v3.1 or higher installed on your computer (DO NOT execute the program yet).
2. Insert the GIS Database CD-ROM into your CD-ROM drive.
3. Open a DOS window and execute the following command:

subst x: <cdrom letter>:

where <cdrom letter> is the letter of your CD-ROM drive.

Add an ODBC Access driver (Needs to be done only once)

1. Go to SETTINGS, CONTROL PANEL, select ODBC.
2. Go to USER DSN (first tab) and choose ADD, add an Access Driver.

3. Enter the database file name (Grasse_River_6-0) in "Data Source Name" without the extension mdb.
4. Adding text under "Description" is optional.
5. Choose SELECT under "Database" to locate your database file (grasse_river_6-0.mdb) in Data_tables folder on the CD-ROM (now the X drive).
6. Click OK and close out of control panel.

To access the Customized Project, execute ArcView and open the project "Grasse_v6-0.apr" found on the CD-ROM (X drive) in the *Customized Project* folder. You will be asked to select a database to connect to, choose X:\Data_tables\Grasse_River_6-0.mdb.

VERY IMPORTANT: The project must be opened from within ArcView. If you try to open it through Windows Explorer or any other application you will get an error "Segmentation Violation" due to read/write restrictions.

NOTE: To delete the x: drive from your Windows Explorer, open a DOS prompt and type the command: subst x: /D

SECTION 1 INTRODUCTION

This appendix summarizes Version 6.0 of the Geographic Information Systems (GIS) Database developed for the Grasse River Project. Data collected as part of the 2005 river investigation, as well as appropriate data from previous investigations (including the Supplemental Remedial Studies [SRS] Program, River and Sediment Investigations [RSI] Phases I and II, and pre-, during- and post-Non-Time-Critical Removal Action [NTCRA] surveys), have been compiled into a single project database. All data were quality controlled for location and attribute data. Data generated after this release will be included in future updates. Data dictionary tables, which define the fields in each file on the CD-ROM, are included electronically on the CD-ROM.

Version 6.0 of the Grasse River Geographic Information System database includes updates from the previous April 2005 release, Version 5.0. These updates are listed in **Table 1-1**.

Table 1-1. Major updates included in Version 6.0.

| Shapefile | Update | Notes |
|--------------------------|--|----------|
| Resfish_bbul_smbs_coords | Coordinates for adult brown bullhead and smallmouth bass collected in 2005 | From BBL |

| Data Table | Update | Notes |
|----------------------|--|------------------|
| Climate | 2005 daily precipitation data through 12/31/05 | From Alcoa |
| Resfish_aro | 2005 Trend Monitoring Survey | From NEA and BBL |
| Riverflow_ChaseMills | 2005 real-time gage height and discharge data | From USGS |
| Riverflow_hist | Daily river flow data (estimated) through 12/31/05 | From USGS |
| Riverflow_tapedown | 2005 flow data | From BBL |
| Water_field | 2005 SRS Routine Monitoring, 2005 Focused Study | From BBL and CDM |
| Water_iupac | 2005 SRS Routine Monitoring | From NEA and BBL |

SECTION 2 CD-ROM CONTENTS

The Grasse River Project GIS Database exists in two formats: a GIS framework and a Microsoft Access database. A CD-ROM (included herein) contains both formats in two separate directories (**Table 2-1**). The first directory (*Shapefiles*) contains all GIS coverages as shapefiles. A listing of these GIS shapefiles is provided in **Table 2-2**. The second directory (*Data_tables*) contains the Microsoft Access database ("Grasse_River_6-0.mdb") which holds all of the related data tables. Information regarding both the GIS and the Access data tables is provided in the data dictionary tables on the Appendix A CD-ROM.

2.1 SPATIAL COVERAGES

2.1.1 Map Projections

A map projection is a set of mathematical equations used to explain the earth's curvature in order to display spatial data in a Cartesian coordinate system. Many different types of projection equations (or systems) have been developed, such as Lambert, Mercator, Albers, and Transverse Mercator. Although it is possible to view spatial data in the earth's coordinate system of geographic, in most cases, it is best to project the data into a standard x-y coordinate system. However, the projection process can not always preserve all four of the maps' primary characteristics of shape, area, distance, and direction. As a result, all states have individually developed standards for mapping which minimize the distortion of these four parameters within the state. Most states have two versions of their projection system -- one based on the North American Datum of 1927 (NAD27) and one based on the datum measured in 1983 (NAD83). It is very important to note that data projected into different coordinate systems cannot be overlaid onto one another. In fact, even data that has been projected into a NAD27 stateplane coordinate system cannot be shown with data projected into the same stateplane coordinate system, using the NAD83 equations. For example, a map of the Grasse River in New York Stateplane East-

1927 would not be shown in the same view as the state of New York, projected into New York Stateplane East-1983.

The projection system for New York is entitled New York Stateplane and uses Lambert Conic Conformal based equations. This system is divided into three areas: East, Central, and West. The Grasse River Project has been projected using the 1983 New York Stateplane-East parameters and equations. The horizontal distance unit is feet.

2.1.2 Basemaps

This section provides a brief overview of the available data in ArcView. The *Shapefiles/basemaps* directory contains the lower Grasse River shoreline, bridge crossings, dams and various other shapefiles. These shapefiles do not have corresponding data files in the *Data_tables* directory. Two shapefiles for the shoreline of the lower Grasse River have been included. The first coverage, called "river.shp", is the river outline provided by BBL¹ and the second coverage "river2.shp" is an older version that originated at HydroQual. The two shorelines match up relatively well, except in a few areas. This offset is noticeable when, for example, sediment sampling locations are overlain on the River. In this instance, some of the locations fall out of the second shoreline ("river2.shp"). Therefore, "river.shp" and "river_shade.shp" (corresponding shading file) should be used when data are overlain within the extent. The shapefiles "river2.shp" and "river2_shade.shp" (corresponding shading file) are included because the detail in the western portion of the river and the delineation of tributaries are more complete. All basemaps are included in the view "General Basemaps" in the customized project (see Section 3.0).

¹Basemap provided by BBL was taken from planimetric mapping prepared by Lockwood Mapping, Inc. using aerial photography (November 9, 1992).

2.1.3 Data Coverages

The *Shapefiles/data* subdirectory contains six main subdirectories: *climate*, *riverflow*, *outfalls_tributaries*, *biota*, *water_qual* and *sed_qual*. Each subdirectory contains shapefiles which are linked to related data tables (found in the Access database located in the *Data_tables* directory) through a "key item." A "key item" is a unique identifier for each station or sample that exists in both the attribute table for the shapefile and a related data table (found in the *Data_tables* directory). This key item is used when linking and joining information to the attribute table for data analysis and display (see Section 2.2.2). The attribute tables of the shapefiles contain only location information, except for the sediment data where additional information is included. The fields contained in the shapefiles are indicated with an asterisk in the data dictionary tables located on the Appendix A CD-ROM.

Climate - This directory contains climate measurements taken at Alcoa Building 65 and a location near Outfall 007 between 1992 and 2005.

River Flow - Flow data from four sources are contained in this directory: 1) real-time gage height and discharge data from the USGS gage at Chase Mills; 2) historic records developed from Oswegatchie River at Harrisville and Grasse River at Pyrites flow records; 3) Grasse River flows estimated from pressure transducer readings taken at the Main Street Bridge in Massena; and 4) paired flow measurements (water column Transect WC001) and tapedown readings (Main Street Bridge) used to develop relationships between stage height and river flow.

Outfalls and Tributaries - This directory contains polychlorinated biphenyl (PCB) concentration data collected from plant facility outfalls during six storm events in 1997.

Biota - This directory contains data collected from resident fish surveys conducted between 1991 and 2005, benthic community assessment surveys conducted in 1993, 1996 and 1998, and caged mussel surveys performed in 1998.

Water Quality - All data pertaining to the water column surveys are included in this directory. These data include: pre-, during- and post-NTCRA surveys conducted in 1995; routine monitoring surveys performed in 1996 through 2005; and special studies conducted in the lower Grasse River (1997 dye study, 1997-1998 storm sampling surveys, 1997-1998 solids monitoring studies at the Main Street Bridge, 1997-1998 groundwater seepage measurements, 1995-2002 semi-permeable membrane device (SPMD) sampling, and 2000-2001 Float Survey).

Sediment Quality - Sediment data collected in 1991 (RSI Phase I), 1993 (RSI Phase II), 1995 (pre- and post-NTCRA), 1997 (Supplemental Remedial Studies), 2000-2001 (Supplemental Sediment Sampling), 2003 (Phases I and II), January 2004, and 2004 (Focused Studies) are contained in this directory. Soft sediment depth data collected in 1992, 2001, 2003, and 2004 are also included. In addition, sediment characterization data as part of the 2001 sediment probing survey and 2003-2004 surveys are included.

2.2 ACCESS DATABASE

2.2.1 Data

Data collected as part of the SRS Program, as well as appropriate data from previous investigations (including RSI Phases I and II, pre-, during- and post- NTCRA surveys), have been compiled into a single Access database ("Grasse_River_6-0.mdb"). The database is located in the *Data_tables* directory (**Table 2-1, right column**) and contains data tables for all of the shapefiles included in the *Shapefiles/data* directory. A total of 31 data tables comprise the database. When applicable, data tables were separated by quantification method (i.e., Aroclor, BZ, IUPAC, etc.). For example, the sediment data exists in Aroclor and BZ format, so two data tables exist for these data ("sediment_aro" and "sediment_bz"). Additional details of the data contained in these tables can be found in the data dictionary on the enclosed CD-ROM.

2.2.2 Linking to Data Tables

The coverages contained in the *Shapefiles* directory (**Table 2-1, left column**) can be viewed using ArcView and the data tables related to the coverages (found in *Data_tables*) can be linked to them for data analysis within ArcView. The steps for linking to a data table are outlined below.

Linking to data tables (Access database) while in ArcView

1. Execute ArcView. In the project window go to PROJECT and select "SQL connect". **Figure 2-1** shows what the user will see in the "SQL connect" window.
2. Under "Connection:" select a database to connect to (Grasse_River_6-0) and click on "Connect..."
3. The individual tables contained in the database will be listed under "Tables". When a table is selected (double-click on the name), all of its fields will be listed under "Columns". The user can choose to view any number or all of a table's corresponding fields (just be sure to bring in the field which contains the key so that it can be linked to the corresponding attribute table later).
4. Double-clicking on the column names will select them and place them in the "Select" window.

5. Queries may be performed at this point to reduce the size of the table that is imported into ArcView. Double-click on the column name to query on and the name will appear in the “where” window. In the example in **Figure 2-1**, the data was queried so that only 1997 data will be in the new table.
6. The tables that result from the queries will be read-only tables and will exist only within the project, however, they can be exported from ArcView into a text file or dbf table. Be sure to name the table in “Output Table”.
7. These tables also may now be linked to their corresponding attribute tables within the project using the key field. Select the field to be linked in both the source table and the attribute table by clicking on the field name (i.e. ‘Key’, ‘Transect’, etc.). Under the table menu, select link.

Every time the main database is updated (and the name remains the same) all related tables and queries are automatically updated within the project. Unlike joining tables, linking tables simply defines a relationship between two tables, rather than appending the fields of the source table to those in the destination. When tables are linked, neither table is changed - they are just linked to one another. After a link is performed, selecting a record in the destination table will automatically select the record or records related to it in the source table. If the destination table is the feature attribute table of a theme, selecting one of the theme's features in the view selects that feature's record in the attribute table and, therefore, automatically selects the records related to it in the source table. Tables are linked based on a field that is found in both tables. The name of the field does not have to be the same in both tables, but the data type has to be the same. You can link numbers to numbers, strings to strings, booleans to booleans, and dates to dates.

Table 2-1. Directory structure for GIS CD-ROM.

| Shapefiles | | Data Tables |
|------------------|-------------------------------|-----------------------------|
| Basemaps | Data | Grasse_River_6-0.mdb |
| bridges | <i>Climate</i> | art_substrate |
| buildings | climate_locat | batch_equil |
| dams | <i>Riverflow</i> | benthic_comm |
| flow_dir | Cmills_Osweg_locat | cap_thickness |
| impoundment | tapedown_locat | climate |
| NY83_locator | transflow_locat | column_flux |
| outfalls | | dye_study |
| potw | <i>Outfalls_tributaries</i> | gw_seepage |
| river | outfall_locat | mussel_aro |
| river_shade | | mussel_bz |
| river2 | <i>Biota</i> | outfall_storms |
| river2_shade | artsubs_locat | pelagic_comm |
| road_labels | benthic_locat | resfish_aro |
| roads | habitat_areas | resfish_bz |
| route_labels | mussel_locat | resfish_peak |
| Seaway_outline | pelagic_locat | riverflow_ChaseMills |
| Seaway_shade | resfish_bbul_smbbs_coords | riverflow_hist |
| WD_canal_outline | resfish_RSI1_locat | riverflow_tapedown |
| WD_canal_shade | resfish_RSI2_TMS_locat | riverflow_trans |
| | resfish_RSI2_TMS_shiner_locat | sed_probe |
| | resfish_SRS_locat | sediment_aro |
| | resfish_YOY_locat | sediment_bank |
| | | sediment_bz |
| | <i>Water_qual</i> | sediment_char |
| | dyestudy_locat | spmd_bz |
| | float_survey_locat | spmd_peak |
| | gw_seepage_locat | water_aro |
| | spmd_locat | water_bz |
| | water_locat | water_field |
| | water_NTCRA_locat | water_peak |
| | | water_iupac |
| | <i>Sed_qual</i> | |
| | cap_thickness_locat | |
| | probing_locat | |
| | sed_probe_locat | |
| | sediment_aro_locat | |
| | sediment_bank_locat | |
| | sediment_bz_locat | |
| | sediment_char_locat | |
| | sediment_geotech_locat | |
| | sediment_stratig_locat | |
| | sediment_type | |

Table 2-2. List of shapefiles on the CD-ROM.

| Shapefiles/Coverages located in <i>basemaps</i> | | | |
|---|--|--------|----------|
| Name | Description | Source | Key Item |
| bridges | Location of bridges on the lower Grasse River | BBL | N/A |
| buildings | Location of Alcoa buildings at the Grasse River site | BBL | N/A |
| dams | Locations of dams on the lower Grasse River | BBL | N/A |
| flow_dir | Flow direction arrows for the lower Grasse River | BBL | N/A |
| impoundment | Outline of the 005 Impoundment | CDM | N/A |
| NY83_locator | Locator Map of NY state (1:2 million scale) | ESRI | N/A |
| outfalls | Locations of Outfalls 001, 004, 005, and 007 | CDM | N/A |
| potw | Location of the Massena water treatment plant on the lower Grasse River | BBL | N/A |
| river | Outline of the lower Grasse River and tributaries | BBL | N/A |
| river_shade | Area of the lower Grasse River | QEA | N/A |
| river2 | Outline of the lower Grasse River | HQI | N/A |
| river2_shade | Area of the lower Grasse River | HQI | N/A |
| road_labels | Road name labels for roads in the vicinity of the lower Grasse River | BBL | N/A |
| roads | Roads in the vicinity of the lower Grasse River | BBL | N/A |
| route_labels | Route number labels for rural routes in the vicinity of the lower Grasse River | BBL | N/A |
| Seaway_outline | Outline of St. Lawrence Seaway in the vicinity of the lower Grasse River | BBL | N/A |
| Seaway_shade | Area of St. Lawrence Seaway in the vicinity of the lower Grasse River | BBL | N/A |
| WD_canal_outline | Outline of the Wiley Dondero Canal | BBL | N/A |
| WD_canal_outline | Area of the Wiley Dondero Canal | BBL | N/A |

| Shapefiles/Coverages located in <i>data/biota</i> | | | |
|---|--|--------|----------|
| Name | Description | Source | Key Item |
| artsubs_locat | 1993 RSI Phase II and 1996 SRS Artificial Substrate Study sampling locations | QEA | Transect |
| benthic_locat | 1993 RSI Phase II, 1996 SRS, and 1998 PBTS benthic community studies sampling locations | QEA | Transect |
| habitat_areas | Fish habitat areas along the Grasse River shoreline | BBL | N/A |
| mussel_locat | 1998 SRS caged mussel survey sampling locations | QEA | Transect |
| pelagic_locat | 1998 PBTS pelagic community studies sampling locations | QEA | Transect |
| resfish_bbul_smbs_coords | 2000-05 coordinates for brown bullhead and smallmouth bass samples | BBL | Key |
| resfish_RSI1_locat | 1991 RSI Phase I (Aroclor) | QEA | Location |
| resfish_RSI2_TMS_locat | 1993 RSI Phase II, 1995 Post-NTCRA, 1996-04 TMS (Aroclor); 1995 Post-NTCRA, 1996-98 TMS (BZ); and 1999-03 TMS (Peak) | QEA | Location |
| resfish_RSI2_TMS_shiner_locat | 1993 RSI Phase II, 1995 Post-NTCRA, 1996-04 TMS (Aroclor); 1995 Post-NTCRA, 1996-98 TMS (BZ); and 1999-03 TMS (Peak) | QEA | Location |
| resfish_SRS_locat | 1995 Pre-NCTRA and 1996 SRS resident fish sampling locations (Peak) | QEA | Location |
| resfish_YOY_locat | 1998-99 YOY (Aroclor and BZ) and 1999 (Peak) resident fish sampling locations | QEA | Location |

| Shapefiles/Coverages located in <i>data\climate</i> | | | |
|---|--|--------|----------|
| Name | Description | Source | Key Item |
| climate_locat | Daily climatic data measured at Alcoa Building 65 and near Outfall 007 | QEA | Location |

| Shapefiles/Coverages located in <i>data\outfall_tributaries</i> | | | |
|---|-------------------------------------|--------|----------|
| Name | Description | Source | Key Item |
| outfall_locat | 1997 storm event sampling locations | QEA | Location |

| Shapefiles/Coverages located in <i>data\river_flow</i> | | | |
|--|--|--------|----------|
| Name | Description | Source | Key Item |
| Cmills_Osweg_locat | Historical (estimated) flow records for the Grasse River at Massena and real-time flow records for the Grasse River at Chase Mills | USGS | Location |
| tapeflow_locat | Paired tapedown measurements from Main Street Bridge and measured flows (at water sampling transect WC001) | QEA | Location |
| transflow_locat | Flows estimated from pressure transducer measurements taken at the Main St. Bridge in Massena | QEA | Location |

| Shapefiles/Coverages located in <i>data\sed_qual</i> | | | |
|--|---|--------|-----------|
| Name | Description | Source | Key Item |
| cap_thickness_locat | 2003 Pre-Phase I measurement locations | BBL | Key |
| probing_locat | 1992 sediment probing transects | BBL | Transect |
| sed_probe_locat | 1992, 2001, 2003, and 2004 soft sediment depths and sampling locations | BBL | N/A |
| sediment_aro_locat | 1991 RSI Phase I, 1993 Rsi Phase II, 1995 Pre- and Post-NTCRA, 1997 SRS, 2000-01 SSS, 2003 Phase II, January 2004, and 2004 Focused Studies Sediment Data (Aroclor) | BBL | Key |
| sediment_bank_locat | 2003 Phase II bank sample locations | BBL | Transect |
| sediment_bz_locat | 1993 RSI Phase II, 1995 Pre- and Post-NTCRA, 1997-98 SRS, 2000-01 SSS, and 2003 Phase I Sediment Data (BZ) | BBL | Key |
| sediment_char_locat | 2001, 2003, and 2004 sediment characterization locations | BBL | Sample_ID |
| sediment_geotech_locat | 2003 Phase II sampling locations for geotechnical cores; note: no associated data table | BBL | Location |
| sediment_stratig_locat | 2003 Phase II sampling locations for stratigraphic cores; see table sediment_aro for data | BBL | N/A |
| sediment_type | sediment type defined during 2003 side scan sonar surveys | OSI | N/A |

| Shapefiles/Coverages located in <i>data\water_qual</i> | | | |
|--|---|--------|----------|
| Name | Description | Source | Key Item |
| dyestudy_locat | 1997 dye study transects | QEA | Transect |
| float_survey_locat | 2000-01 float survey sampling transects | QEA | Transect |
| gw_seepage_locat | 1997-98 groundwater seepage meter locations | CDM | Key |
| spmd_locat | SPMD transects for SPMD sampling studies | QEA | Transect |
| water_NTCRA_locat | 1995 local water sampling locations during-NTCRA | BBL | Location |
| water_locat | Water column transects for water quality sampling studies | QEA | Transect |

SQL Connect

Connection:

| Tables | Columns |
|--------------------|-----------|
| riverflow_hist | Sample_id |
| riverflow_tapedown | Type |
| riverflow_trans | Year |
| sed_probe | Month |
| sediment_aro | Day |
| sediment_bz | Rmile |

Owner:

Select:

from:

where:

Output Table:

Figure 2-1. SQL connect window.

SECTION 3 CUSTOMIZED PROJECT

Included on the CD-ROM is a customized ArcView project that is meant to give the user an overview of the available data. In addition, three macros have been developed to assist in navigating around the project.

A brief description of the views contained in the customized project is provided in **Table 3-1**. As part of this project, a number of the related tables have been imported into the project and linked to their corresponding spatial coverages. Linked tables for each spatial coverage are listed in the Comments window under the Theme:Properties menu item. All spatial coverages in the Customized Project have linked tables. Data not included in the project can be linked to their corresponding coverages using the key item listed in the data dictionary and the procedure discussed in Section 2.2.2. **Figure 3-1** shows an example window of one of the views, "Water Data", in the project. The left side of the window shows the various coverages available for viewing. Clicking in the box next to the shapefile name will display it on the map

Within the customized project, there are three macros to assist the user in project navigation and data analysis. These macros are invoked by buttons on the far right-hand side of the toolbar. The first macro, zoom to reach, is executed by the blue diamond button on the top toolbar. This tool assists in viewing different reaches of the lower Grasse River. Five extents are available for viewing: upstream of the plant facility, in the vicinity of the plant facility, in the vicinity of the Unnamed Tributary, the lower portion of the river, or the full extent of the lower Grasse River.

The second tool is meant to assist in viewing data tables which have been linked to themes within a view. A number of tables have already been linked to themes within the customized project. However, this tool will also work on additional tables that are imported and linked. This macro is invoked by clicking on the eyeglass icon on the far right-hand side of the bottom toolbar. Once activated, data tables may be viewed by making the theme being analyzed active in the table of contents of the view and selecting the points or transects of interest. Upon

selection, the points (or transects) will turn yellow and all the available linked tables will open, showing the related data (also in yellow). Multiple points and transects can be selected from the same theme by holding down the shift key and clicking or drawing a rectangle around the points within the view.

The third tool produces a simple statistical analysis of selected data from a chosen linked table. To activate this tool, select the calculator button from the right-hand side of the bottom toolbar, make active the theme within the table of contents and draw a polygon around the points to be analyzed (**Figure 3-2**). The macro will then step through a series of windows to determine how statistics should be performed. The first window (**Figure 3-3, panel a**) displays the available linked data tables – the table that contains the data to be analyzed should be chosen. The second window (**Figure 3-3, panel b**) displays the fields within that linked table that will narrow the choices for the statistics. For example, to compute statistics for a particular survey, choose the field ‘Survey’ in this window. Another example may be to choose the field ‘Year’ if statistics are to be performed for a single year. Once the field for sub-selection is chosen, select the criteria for sub-selection in the next window. In **Figure 3-3 (panel b)**, ‘Year’ was chosen, so that in **Figure 3-4 (panel a)**, either 1995 or 1997 can be selected for the analysis. After the data is narrowed down, the last step is to select the field on which to perform the statistics (**Figure 3-4, panel b**) – this field must be numeric and is typically a measured parameter such as TSS or total PCBs. The results of the calculation are displayed in a final window (**Figure 3-5**). Please note that this statistics tool is meant for general analysis. Although the macro does ignore data points designated as –999 (no data available), it does not account for below detection limits values that may be listed as negative in the database (i.e. TSS data). Currently, negative values are included in the statistical analysis. Advanced analyses should be performed with tools other than this statistical macro.

Table 3-1. List of views in customized project.

| View Title | Description |
|-------------------------------------|---|
| Caged Mussels Data | Data from survey conducted in 1998. |
| Flow and Climate Data | Climate measurements taken at Alcoa Bldg 65 and a location near Outfall 007 between 1992 and 2005. Flow data from 4 sources. |
| General Basemaps for Grasse River | Basemaps of shorelines, dams, canals, roads, and cities. |
| Habitat Areas | Aquatic/resident fish habitat showing littoral vegetation areas from 1997 surveys. |
| Macroinvertebrate Community Studies | Data from surveys conducted in 1993, 1996 and 1998. |
| Outfall Data (Storm Event) | PCB data collected from plant facility outfalls during 6 storm events in 1997. |
| Resident Fish Data | Data from surveys conducted between 1991 and 2005. |
| Sediment Characterization | Sediment characterization data collected during 2001 soft sediment probing survey, 2003 Phases I and II, January 2004, and 2004 Focused Studies; cap thickness measurements from 2003 pre-Phase I survey. |
| Sediment Data | Data from surveys conducted in 1991 (RSI Phase I), 1993 (RSI Phase II), 1995 (pre- and post-NTCRA), 1997, 2000-01, 2003, and 2004. |
| Sediment Probing Data | Soft sediment data from surveys conducted in 1992, 2001, 2003, and 2004. |
| SPMD Data | PCB data collected during surveys in 1995 and 1997 through 2002. |
| Water Data | Data from pre-, during- and post-NTCRA surveys in 1995, routine monitoring and storm monitoring surveys in 1996 through 2005, groundwater seepage measurements from 1997-98, float surveys in 2000-01, and a dye study performed in 1997. |

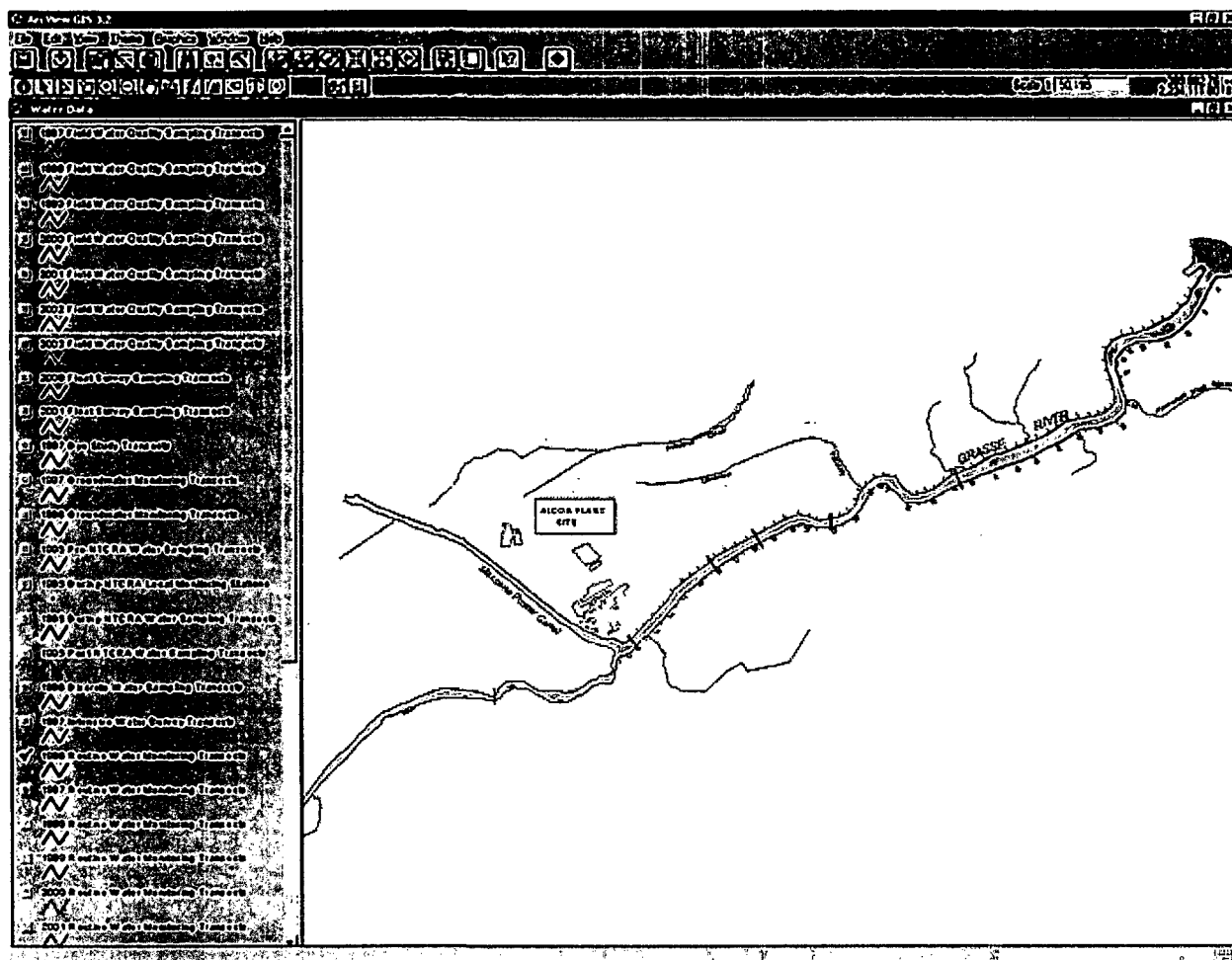


Figure 3-1. Example view in customized project.

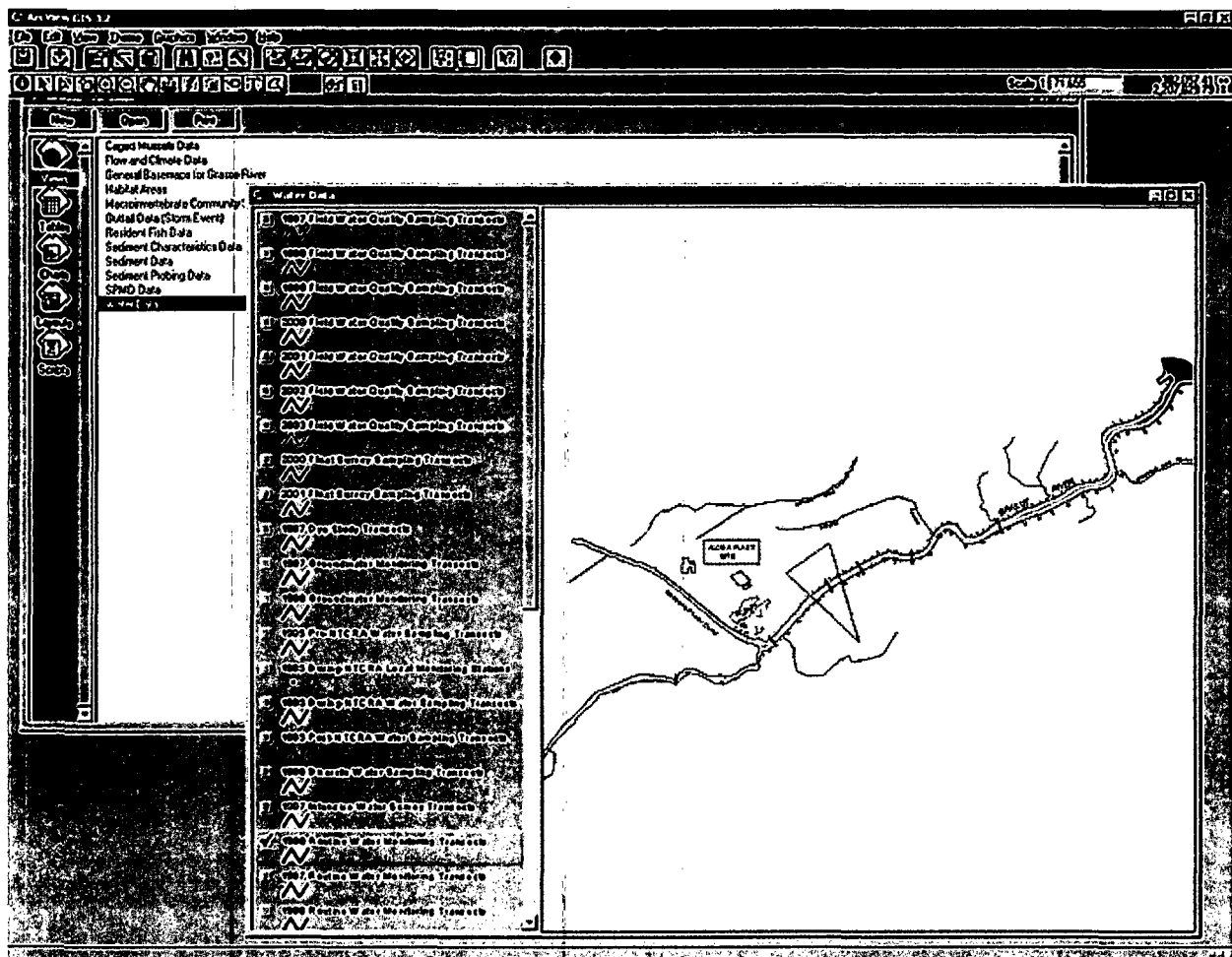
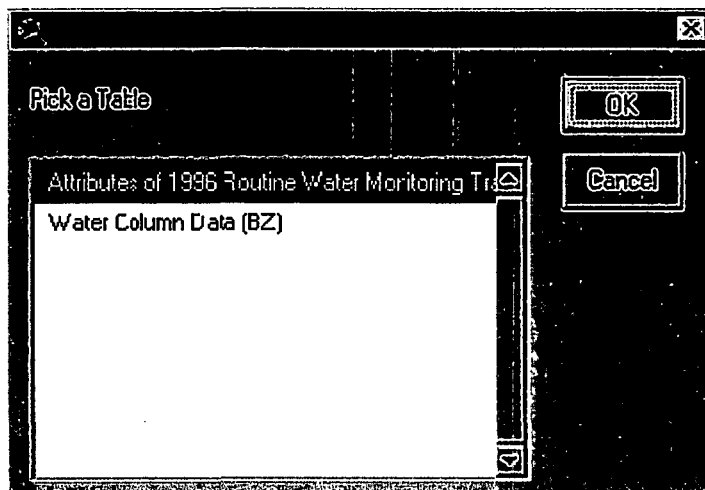


Figure 3-2. Example of a select polygon for the 'Statistics by Polygon' tool.

a)



b)

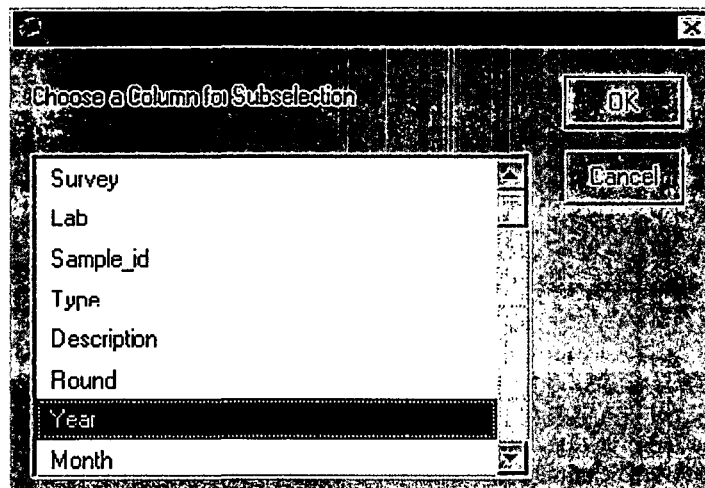
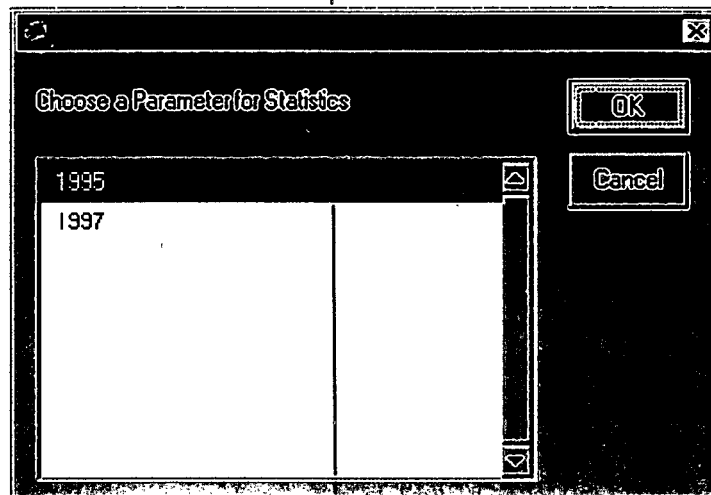
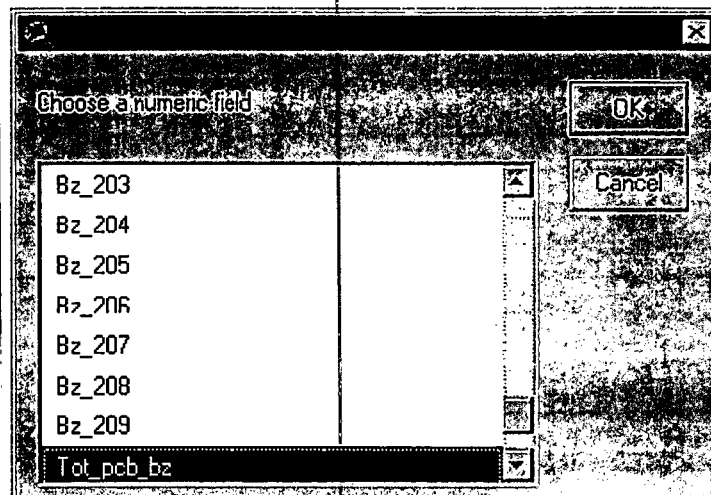


Figure 3-3. Example windows for the 'Statistics by Polygon' tool where user is queried for related table (a) and the field on which to perform the sub-selection of data for analysis (b).



a)



b)

Figure 3-4. Example windows for the 'Statistics by Polygon' tool where the user is queried on the criteria for sub-selection (a) and the field on which to perform the calculation (b).



Figure 3-5. Final window displaying results of the 'Statistics by Polygon' macro.

SECTION 4

DATABASE UPDATES AND FUTURE WORK

The Grasse River Project GIS Database (v6.0) contains data collected in the lower Grasse River between 1991 and 2005. As monitoring programs in the lower Grasse River continue, additional data will be generated, checked for quality control and incorporated into the database. These updates will be transferred to Alcoa on a periodic basis, depending on the extent of the changes and the additions that occur. When revisions do occur, the version number for the database will be upgraded and an addendum to this report will be released. In most cases, a new CD-ROM also will be released. Future releases will contain the entire database, including all previous coverages and data, along with any new or updated information.

Appendix B

APPENDIX B

Technical Memorandum

Grasse River Project 2005/2006 River Ice Monitoring Documentation Summary

Table of Contents

| | | |
|-----|---|----|
| 1.0 | Introduction | 1 |
| 2.0 | Climatological Conditions | 1 |
| 3.0 | River Stage Monitoring..... | 2 |
| 3.1 | River Stage During Ice Formation | 2 |
| 3.2 | River Stage During Ice Breakup | 3 |
| 4.0 | Monitoring of River Ice Formation and Extent..... | 4 |
| 5.0 | Ice Thickness Measurements and Simulation | 4 |
| 5.1 | Ice Thickness Measurements | 5 |
| 5.2 | Ice Thickness Simulations | 5 |
| 6.0 | Monitoring of River Ice Breakup..... | 7 |
| 6.1 | Pre-Breakup Observations | 7 |
| 6.2 | Field Observations During Breakup | 8 |
| 7.0 | Summary and Conclusions..... | 10 |
| 8.0 | References | 12 |

List of Tables

| | | |
|---|---|----|
| 1 | Grasse River Ice Monitoring Locations | 13 |
| 2 | Grasse River Ice Thickness Measurements – March 3, 2006 | 14 |

List of Figures

| | | |
|---|---|----|
| 1 | 2005/2006 Grasse River Ice Monitoring Locations | 15 |
| 2 | Typical Water Surface Elevation | 16 |
| 3 | Air Temperature and Stage Height for Winter 2005/2006..... | 17 |
| 4 | Precipitation Data and Stage Height for Winter 2005/2006 | 18 |
| 5 | Grasse River Stage Height and Flow for Winter 2005/2006 – Chase Mills, New York USGS Gaging Station | 19 |
| 6 | Grasse River Stage Height for Winter 2005/2006 – Alcoa Outfall 001 Staff Gage..... | 20 |
| 7 | Stage Height and Flow for the Spring 2006 Ice Breakup - Chase Mills USGS Gage and Outfall 001 Staff Gage | 21 |
| 8 | Lower Grasse River Ice Thickness Forecasting Model Simulated Thickness and 15-Day Forecast – January 30, 2006..... | 22 |

| | | |
|----|---|----|
| 9 | Lower Grasse River Ice Thickness Forecasting Model Simulated Thickness Through March 3, 2006 | 23 |
| 10 | Lower Grasse River Ice Thickness Forecasting Model Simulated and Predicted Thickness through Breakup..... | 24 |
| 11 | Lower Grasse River Approximate Location of Ice Cover – March 28-30, 2006..... | 25 |
| 12 | Lower Grasse River Photographs During 2005/2006 Ice Breakup..... | 27 |

List of Attachments

- A Photo Library – Winter 2005/2006 River Ice Monitoring (CD)
Video Documentation of Lower Grasse River Ice Breakup, March 28 - 31, 2006 (DVD)
- B Memo and Aerial Photos – “Pre-Breakup Ice Conditions on Grasse River, March 24, 2006”, Andy Tuthill, CRREL, March 27, 2006

1.0 Introduction

The Grasse River flows to the northeast approximately 55 miles from a dam located at Pyrites, New York to its confluence with the St. Lawrence River approximately 7 miles east of Massena, New York. A topographic map of the final 16 miles of the river is illustrated in **Figure 1**, and a profile of the normal water surface elevations along the 55-mile length of the river is provided as **Figure 2**. The "lower Grasse River" is the reach beginning downstream of the Massena Power Canal in the Village of Massena; remediation options are being studied to address polychlorinated biphenyl (PCB) contamination in the sediments in this reach of the river.

In March 2003, an ice jam formed in the lower Grasse River that resulted in the scouring of a portion of the bed sediments. During the past three winters, observations were made of the ice formation and breakup process on the river. As in those previous winters, monitoring has been conducted to document ice formation and breakup during the winter of 2005/2006. The monitoring was conducted as specified in the *2005/2006 Grasse River Monitoring Work Plan* (Alcoa, December 2005); the information gathered is summarized in this technical memorandum. Two deviations from the work plan occurred during the project, one being that the monthly tape down measurements from the Alcoa Bridge and Main Street Bridge were not collected as planned due to an inadvertent oversight by the project team, and the second being that only a single set of ice thickness measurements was collected due to safety considerations related to thin ice/open water. This memorandum includes an analysis of the available data and conclusions regarding the potential for an ice jam event to have disturbed the river sediments in the lower Grasse River during the 2006 spring ice breakup.

Field observations and data were gathered largely by Camp Dresser & McKee (CDM), and supplemented with aerial inspection and photography by Andrew M. Tuthill of the U.S. Army Corps of Engineers, Cold Regions Research & Engineering Laboratory (CRREL). Additional ice modeling technical support was provided by Clarkson University who supplied the model for the formation and decay of ice in the lower Grasse River. The results and conclusions in this memorandum were reviewed and accepted by a team of ice experts that included Mr. Tuthill (see above), Dr. Hung Tao Shen of Clarkson University, Dr. George Ashton (CRREL, retired), and Mr. Guenther Frankenstein (CRREL, retired).

2.0 Climatological Conditions

The climatological data used for this study were measured at Massena International Airport. The daily maximum and minimum temperatures during the winter of 2005/2006 are shown in **Figure 3**. Average temperatures were unseasonably warm during the winter of 2005/2006 in comparison to recent years, as depicted in the comparison below.

| Month | 2001-2005 Monthly Average Temperature (°F) | 2005/2006 Monthly Average Temperature (°F) |
|----------|---|---|
| December | Not Accessed | 21 |
| January | 13 | 24 |
| February | 16 | 21 |
| March | 27 | 31 |
| April | 37 | 43 |

Data Source: Weather Data from Massena Airport from 2001 - 2006

Between December 1, 2005 and March 31, 2006, daytime highs were above freezing when averaged on a weekly or biweekly basis. On only three occasions and for short periods (one to three days), nighttime lows were at or below -7 degrees Fahrenheit (°F). Average temperatures fluctuated near the freezing point until March 23, 2006 when the air temperature began to rise above freezing. Temperatures of up to 76°F were observed on March 31, 2006.

Daily precipitation data during the winter of 2005/2006 are shown in **Figure 4**. Due to the various forms of winter precipitation (e.g., snow or icy rain), on many occasions the amount of precipitation cannot be measured accurately and is reported as "trace". There were four notable precipitation events between December 1, 2005 and April 1, 2006, when daily precipitation exceeded 0.5 inches. The most significant precipitation event of 1.15 inches occurred on January 18, 2006.

3.0 River Stage Monitoring

3.1 River Stage During Ice Formation

Provisional real-time stage height and flow (discharge) data for the U.S. Geological Survey (USGS) gaging station at Chase Mills (#04265432) were downloaded for the period of December 1, 2005 to April 30, 2006 from the USGS website (**Figure 5**)[<http://waterdata.usgs.gov/nwis/uv/?site=04265432>]. The gage is located approximately 11 miles upstream of Massena and has been in operation since the end of 2003. As shown in Figure 5, flow is not calculated and reported by USGS during periods when ice is present, due to ice-related backwater effects. This is common among stream gaging stations in the northern U.S. This has occurred during the past three winters and will likely occur in future winters.

The daily average river flow was approximately 1,700 cubic feet per second (cfs) on December 6, 2006, when ice formation began in the upper Grasse River. Complete ice cover in the lower Grasse River was observed on December 12, 2006. Due to ice-related effects, no flow readings were available from the Chase Mills gage between December 7, 2005 and March 12, 2006.

Stage height readings at Alcoa's Outfall 001 gage are shown on **Figure 6**, for the December 1, 2005 to April 30, 2006 timeframe. These same stage height data are also shown in **Figure 3**, in comparison to daily air temperatures. Outfall 001 is located approximately 1,250 feet downstream of the Alcoa Bridge (**Figure 1**). The stage height information is automatically recorded every five minutes at this station throughout the year, and downloaded by the Alcoa Massena Operations ChemLab for data storage. The plots in **Figure 3** and **Figure 6** include all of the 5 minute interval data.

As shown in **Figure 3** and **Figure 6**, the stage height at Outfall 001 displayed unusual spikes on December 13, 2005, December 21, 2005, and February 27, 2006. These spikes coincided with the coldest air temperatures measured in the winter season (at or below -7°F). The extreme fluctuations in stage height during these periods have been observed in prior years and are believed to be the result of either frozen water in the vicinity of the gage or short-term malfunctioning of some of the gage components due to the severe temperatures and, thus, not representative of typical conditions. A close examination of these data spikes indicates variations of 1 to 1.5 feet sometimes within five minute time intervals. During the monitoring periods in question, the river had an intact ice cover and therefore water surface elevation variations of this magnitude were not physically possible. **Figure 4** presents the calculated daily average stage height for Outfall 001, with the raw data that exhibit anomalous short term spikes on December 13 and December 21, 2005, and February 27, 2006 removed from the calculations.

Based on **Figure 4**, the daily average stage height at Outfall 001 was 5.33 feet on December 12, 2006, when a complete ice cover was first observed in the lower river.

Relative river stage data from "tape-down" measurements at the Main Street Bridge and Alcoa Bridge were not collected as specified in the Work Plan (Alcoa, December 2005) as described above. Given the availability of more reliable stage data from the Chase Mills and Outfall 001 gages, the elimination of tape-down measurements should be considered for the 2006/2007 river ice monitoring period.

3.2 River Stage During Ice Breakup

To evaluate river stage during the spring breakup period, the stage height and flow data for the USGS gaging station at Chase Mills were downloaded for the period of March 24 to April 5 (**Figure 7**). A minor increase of 0.2 ft in stage height (500 cfs in flow) from March 24 to March 27 was likely attributed to ice melt, since there was no rainfall at that time. The flow remained stable at approximately 1,200 to 1,500 cfs through the observed breakup period of March 28 through March 31. Therefore, the flow during breakup was similar to the flow at freezeup (1,700 cfs on December 6, 2005). As discussed in Section 5.2, an increase in flow of at least 3,500 cfs between freezeup and breakup has been previously cited as a threshold condition for mechanical ice breakup and potential ice jams for the lower river.

Stage height readings at Alcoa's Outfall 001 gage are also shown on Figure 7. The stage record indicated that the river stage varied less than a foot over the time period between March 24 and April 5. Stage height at Outfall 001 varies in response to water releases from the Robert Saunders-Robert Moses Power Dam, located in the St. Lawrence River near the mouth of the Grasse River, based on energy demand. Diurnal fluctuations on the order of one foot have previously been observed in the lower river, with highest water levels generally occurring during the late afternoon hours and lowest in the early morning hours.

Because no increases in stage height are observed other than the expected daily pattern, the stage height record at Outfall 001 does not indicate any ice jam formation in the lower Grasse River during the observed ice breakup period of March 28 through March 31, 2006.

4.0 Monitoring of River Ice Formation and Extent

The extent of ice cover on the Grasse River was monitored periodically at the 15 locations shown in Figure 1. A listing of the monitoring locations is included as **Table 1**. Dated photographs looking both upstream and downstream were taken at each location, as included in **Attachment A**. The photographs are numbered to correspond with the locations shown in Figure 1. Photographs were taken approximately once a month beginning in early December and more frequently when the ice cover began to deteriorate in late March 2006.

The lower Grasse River below the Alcoa Bridge (Location #7 in Figure 1) was fully covered with ice by December 12, 2005, with the exception of the immediate vicinity of Outfall 001. Based on previous analysis of ice formation mechanisms for the lower Grasse River, as conducted by the ice expert group (see Section 1.0), it is believed that ice extends to the center of the river through a combination of thermal border ice growth and juxtaposition of frazil ice slush and flow arriving from the steeper, faster flowing upstream reaches. This is the typical mode of ice formation in areas of the Grasse River that have low flow velocities. In these areas of the river, the ice remains stationary through the winter with little to no visible distortion.

In areas of the river with rapids or sharp drops in elevation, namely within Massena, Louisville, and Chase Mills, the ice takes longer to form and typically does not completely cover the river. The mode of ice formation is similar to that described above.

5.0 Ice Thickness Measurements and Simulation

Ice thickness measurements were collected on March 3, 2006 to document the intact ice cover thickness at three locations in the lower Grasse River during the mid-winter period. Thickness measurements were also collected at two upper Grasse River locations. Attempts were made to collect additional thickness measurements in January, February,

and at or near the time of breakup. However, thin or unformed ice near the river access points prevented crews from accessing the ice safely.

Alcoa utilized a computer simulation model to forecast ice formation and decay during the winter 2005/2006 period (Alcoa, April 2006). The model uses actual and forecasted temperature data, as collected at Massena International Airport.

The ice thickness measurements and ice thickness simulations are presented in the following subsections.

5.1 Ice Thickness Measurements

On March 3, ice thickness measurements were made at the following five locations (Figure 1): Location 1 (Amvets), Location 4 (Route 131 Bridge), Location (Outfall 001), Location 10 (Route 37 Bridge), and Location 15 (Madrid Bridge). A motorized auger was used to bore 8-inch diameter holes in the ice. A tape measure or graduated probe was used to hook onto the bottom of the ice cover and measure upward to the top of the borehole. The total depth of material was visually differentiated between solid ice and porous snow cover or slush. On March 3, 2006, no porous snow cover or slush was observed on top of the ice cover. Furthermore, no frazil ice was observed underneath the ice cover. Photos of the boreholes are included in Attachment A.

To calculate an average ice thickness at each location, measurements were made at three boreholes spaced across the river. One borehole was drilled at or near the center of the river. The left and right boreholes (orientation facing downstream) were located at approximately one quarter of the river width from the respective shorelines. The ice thickness measurements are summarized in **Table 2**.

Due to variations in river conditions, such as water depth and streamflow, the ice thickness measurements on March 3, 2006 were differentiated between the lower and upper Grasse River. Average ice thickness in the lower Grasse River was approximately 16.5 inches. The maximum ice thickness was 19.5 inches (Location 6 – center) and the minimum ice thickness was 11.5 inches (Location 4 – center). Average ice thickness in the upper Grasse River was approximately 14.7 inches. The maximum ice thickness was 18.5 inches (Location 10 – right) and the minimum ice thickness was 11.5 inches (Location 15 – left).

5.2 Ice Thickness Simulations

As discussed in the hindcasting analysis provided in Section 4 and Appendix N of the *Draft Addendum to the Comprehensive Characterization of the Lower Grasse River* (Alcoa, April 2004), mechanical ice breakup and ice jams may occur in the lower Grasse River when the discharge increase from freezeup to breakup exceeds about 3,500 cfs; and the ice at the time of breakup is thicker than approximately 15 inches. Reaching these conditions does not necessarily mean that ice jams sufficient to disturb sediments would form, but these conditions are considered to be the threshold of concern in relation to an ice jam event that can result in a significant disturbance of the bottom sediments, as was

observed during the 2003 ice jam event. In the spring breakup of 2005, minor sediment disturbance was documented even though ice thickness and flow conditions were outside of these threshold conditions. Forecasting of air temperature, rainfall, and ice thickness in a given year can help to predict whether these threshold conditions may be met during the breakup period. These forecasts can also help determine when a mechanical breakup may occur, and could be useful in the event that a feasible interim ice management option (e.g. ice breaking) is identified for the river.

Throughout the winter, the growth and decay of the ice cover thickness were simulated using actual and forecasted air temperature data from Massena International Airport. Together with river flow and/or rainfall data, the simulated ice thickness can potentially be used to predict the time of ice breakup and whether a mechanical ice breakup is likely to occur. Mechanical ice breakup in the upper Grasse River can lead to ice jams in the lower river if an intact ice cover of sufficient strength exists in the lower river that would prevent the continued movement of ice floes entering the lower river from upstream.

In 2004/2005, Clarkson University applied a forecasting methodology using the "unified degree method," similar to the winter "hindcasting" analysis included as Appendix N of the *Draft Addendum to the Comprehensive Characterization of the Lower Grasse River* (Alcoa, April 2004). Rather than using climate data to retroactively predict ice cover thickness at the time of breakup in a given year, Clarkson used the actual and forecasted 2004/2005 air temperature data to predict the ice cover thickness through its growth and decay. The thickness simulation generally applies to the stable pools of the river, not the area of rapids.

This approach to ice thickness modeling was again used in 2005/2006. Ice cover thickness simulations were started on December 12, 2005 and continued through March 31, 2006. A 15-day air temperature forecast was periodically uploaded into the model to generate a graph showing predicted ice cover thickness in relationship to the winter calendar. As the winter progressed, the "predicted thickness" portion of the curve was replaced by a "simulated thickness," based on the actual air temperatures that were measured. An example of the simulated and predicted ice thickness up to January 30, 2006 is provided as **Figure 8**.

Figure 9 graphs the simulated ice thickness over the winter based on actual air temperatures, until the ice thickness measurement event on March 3. For comparison, the measured maximum and minimum thickness values and calculated average (Table 2), are also shown in Figure 9. On March 3, the average ice thickness measured in the lower Grasse River was 16.1 inches (19.5 inches maximum) while the simulated ice thickness was estimated at 21.8 inches. Safety concerns regarding ice thickness prevented field measurements until March 3; therefore, no prior comparison with the simulated ice thickness was possible.

The 5.7 inch differential between the simulated and measured average ice thickness is not surprising, considering the unusual quantity of rainfall experienced prior to March 3. As shown on Figure 9, at least six days of above-freezing average daily temperatures and

2.64 inches of rainfall were reported between ice cover formation on December 12, 2005 and the thickness measurements on March 3, 2006. Rainfall will generally result in decay of an intact ice cover. However, ice cover decay due to rainfall is difficult to quantify, and is not factored into the ice thickness simulation model, which is based solely on air temperature.

Figure 10 shows the results of the ice thickness simulation through early April 2006. Starting March 3, 2006, the model was adjusted and set to the measured average ice thickness of 16.1 inches. Forecasted air temperature was used to predict ice thickness as of March 21 and 27, 2006. Actual average daily air temperature was used to simulate the entire month until March 27. The maximum simulated ice thickness was 17.6 inches by March 24, before it was predicted to decay. Beginning on or about March 23 and through March 31, warm air temperatures were forecasted to cause a rapid decrease in ice thickness. The simulated progression of melt-out began on March 25 at 13 inches, decayed to 5 inches by March 27, and ended with complete melt-out by March 29. The modeling predictions are based on the assumption that no mechanical ice breakup occurs during the ice out period, which is consistent with observations during the spring of 2006.

The simulated ice thickness shown in Figure 10 indicates that complete melt-out should have occurred on March 29. This correlates roughly to the visual observations made of the breakup period (see Section 6 below), which documents ice decay and movement during the daylight hours from March 25 through March 31.

6.0 Monitoring of River Ice Breakup

The monitoring of the Grasse River intensified at the end of March as air temperature began to increase significantly. Prior to the complete breakup of ice, an aerial site reconnaissance was performed via airplane and photographs of ice cover decay were taken. During breakup, field crews were stationed along the Grasse River to visually observe and document the ice breakup event.

Subsections 6.1 and 6.2 below document the pre-breakup observations (aerial survey) and the field observations during breakup, respectively.

6.1 Pre-Breakup Observations

On March 24, 2006, Andy Tuthill of CRREL made an over flight of the Grasse River and provided both a written summary (**Attachment B**) and oblique aerial photographs (**Attachment A**) of the ice cover. These observations are incorporated by reference to this memorandum, and have been factored into its conclusions. A brief summary of those observations is included below.

“In general, the river was about 80 percent ice-covered for its lowermost 20 miles. Most of this ice cover consists of decaying sheet ice, varying in color from whitish to dark, and the ice does not appear to be very thick or very strong. Rapids and sections of faster-moving water were open.”

"Barring occurrence of an extremely dynamic, rainfall-triggered breakup event, there does not appear to be sufficient ice volume in the upper river to supply a severe ice jam in the lower river."

6.2 Field Observations During Breakup

With a significant increase in air temperature predicted from March 23 through March 31, 2006, field crews were mobilized to intensify monitoring of river ice conditions per the 2005/2006 Grasse River Ice Monitoring Work Plan (Alcoa, December 2005). Observations by the field crews are summarized below for the March 25 to March 31, 2006 timeframe, during which the melt-out occurred. Field observations from the lower Grasse River are translated into a depiction of the approximate limits of the ice cover on March 28-30 (**Figure 11**). Video documentation of the final stages of ice breakup is included on a DVD in Attachment A.

March 25 - Dark gray and white ice cover was present at and downstream of the Massena Power Canal. Open water was observed along the north shoreline along east/west sections of the lower Grasse River, excluding near Haverstock Road (Location 2) and Amvets (Location 1).

March 26 - The ice cover was observed to be similar to the March 25 observations. A slight increase in thermal decay was evident as shown with an increase in areas of open water.

March 27 - The majority of the ice cover remains intact. Thermal decay was starting to increase significantly due to an increase in air temperature. Several large ice sheets near the Alcoa Bridge (Location 7) and Outfall 001 (Location 6) have begun to shift slightly downstream.

March 28, 2006: 1:00PM until 3:00PM - Ice observations in the lower Grasse River showed limited and thin ice cover in the vicinity of the Power Canal.

Ice cover downstream of the Alcoa Bridge was also thin and open water was observed, as shown in **Figure 12a**, particularly along the northern shoreline from the Capping Pilot Study Area (Location 5) until the Route 131 Bridge (Location 4). The intact ice sheets at that location remained thin and moved very slowly.

Ice cover downstream of the Route 131 Bridge spanned the width of the river but appeared thin and pitted due to thermal decay. Similar ice conditions were present at Massena Center (Location 3).

Ice cover spanned the width of the river from upstream of Haverstock Road to downstream of the Amvets Property, with the exception of a small area of river about 500 feet downstream of Haverstock Road.

March 29, 2006: 10:00AM until 11:00AM – There was no ice cover upstream of the Alcoa Bridge. The tail of the ice cover was located adjacent to Outfall 001. The ice cover at this location appeared thin and floated downstream in large sheets. This pattern of ice melt was common between Outfall 001 and the Route 131 Bridge.

Ice cover downstream of the Route 131 Bridge was similar to the March 28 observation; however, an increase in thermal decay was evident. Immediately downstream of the bridge, open water was visible in the center of the ice cover that had spanned the width of the river on March 28 from 1:00PM until 3:00PM, as shown in **Figure 12b**.

Ice cover from upstream of Haverstock Road (Location 2) to downstream of Amvets (Location 1) was also similar to the March 28 observation. Small areas of open water near the north shoreline were observed to form.

March 29, 2006: 2:30PM until 3:30PM – The tail of the ice cover had floated downstream from Outfall 001 and was in the vicinity of the Capping Pilot Study Area. The ice cover was observed to be thin and in large sheet formations.

Downstream of the Route 131 Bridge, the ice cover continued to show thermal decay. Ice cover along both shorelines immediately downstream of the Route 131 Bridge was still intact. The ice cover near the Massena Center bridge was similar to the previous observation; however, additional ice cover melt was observed.

Ice cover from upstream of Haverstock Road to downstream of Amvets remained largely intact across the width of the river. Slightly larger areas of open water were observed in sporadic locations as documented during previous observations.

March 29, 2006: 5:00PM until 5:30PM – The ice cover upstream of the Route 131 Bridge remained in approximately the same locations as previously observed. Only minor downstream shifts were observed. The ice cover from the Capping Pilot Study Area to upstream of the Route 131 Bridge has also showed a slight increase in thermal decay.

Immediately downstream of the Route 131 Bridge, no ice cover was present. Some remaining ice sheets have floated downstream and were observed to be situated similarly to the previous observation. At this time, a slight increase in ice cover at Massena Center was observed due to ice floes from upstream of the Route 131 Bridge and the former ice cover downstream of the Route 131 Bridge.

Again, from upstream of Haverstock Road to downstream of Amvets, the ice cover continues to span the width of the river, with the exception of previously noted open water areas. These open water areas continue to increase.

March 30, 2006: 8:00AM until 9:00AM – The only ice upstream of the Route 131 Bridge that remained was located immediately adjacent to the upstream side of the

bridge. Medium size ice sheets, slightly thicker than previously observed, have accumulated at this location due to a constriction in the river width from the bridge piers, as shown in **Figure 12c**. Little to no ice movement was observed.

Downstream of the Route 131 Bridge was predominantly open water, with the exception of some thin ice sheets remaining near Massena Center, as shown in **Figure 12d**.

As previously stated, from upstream of Haverstock Road to downstream of Amvets, the ice cover still spans the width of the river, with the exception of previously noted open water areas. These areas continue to increase. Ice cover was becoming increasingly thin at Haverstock Road and the Amvets property.

March 30, 2006: 5:00PM – Very thin ice sheets remain at Haverstock Road and slightly upstream. Open water was predominantly present. Two larger sheets of ice span the width of the river at Amvets. These sheets were composed of several smaller sheets and were observed to be thin and weak.

March 31, 2006: 8:00AM – Ice cover was still present at Amvets and was extremely thin. **Figure 12f** illustrates the presence of thin ice cover at Amvets.

A follow-up field reconnaissance at Amvets revealed that the remaining ice cover at Amvets had flowed to the confluence with the St. Lawrence River and was discharged downstream early afternoon on March 31.

The breakup conditions, as described above and viewed through photographs and video documentation, did not indicate any significant potential for an ice jam that would produce a bed scouring event. Furthermore, neither an ice run from the upper Grasse River nor an accumulation of ice debris in the lower river was visually observed.

7.0 Summary and Conclusions

Periodic visual observations were made of the lower 30 miles of the Grasse River during the winter of 2005/2006 and a photographic record was developed from observations at 15 locations (Attachment A). The lower Grasse River below the Alcoa Bridge (Location #7 in Figure 1) was fully covered with ice by December 12, 2005, with the exception of the immediate vicinity of Outfall 001. No mid-winter breakup was observed in 2006. The results of ice thickness simulation modeling also did not indicate evidence of a mid-winter breakup.

Ice thickness measurements were made at five locations in the upper and lower Grasse River on March 3, 2006, with the average ice cover thickness measured as 16.1 inches among the three lower river locations. The growth and decay of the ice cover was numerically simulated during the winter of 2005/2006 using a model developed by Clarkson University. The model predicted greater ice thickness than what was measured on March 3, 2006. The difference in predicted versus measured thickness is likely due to

rainfall events during December-February. The model does not account for ice decay due to rainfall.

For the period of March 3 through March 27, the model utilized the average measured thickness of 16.1 inches as the starting thickness. The model predicted a maximum ice cover thickness of 17.6 inches by March 24, before it started to decay. Beginning on or about March 23, warmer air temperatures were predicted to cause a rapid decrease in ice thickness (Figure 10). An aerial reconnaissance conducted on March 24 observed a general deterioration of the ice cover in the upper reaches of the river, as well as stretches of open water in areas of faster-moving flow (Attachment B). The ice thickness was forecasted to be 9.0 inches on March 26, with complete melt-out by March 29, unless a mechanical breakup was to occur. This roughly correlated to the visual observations made of the breakup period, where the actual date of complete ice melt-out was March 31, 2006.

An extended period of above-freezing temperatures (March 22-31) with no precipitation resulted in the gradual deterioration and thermal melt-out of the ice cover, without a mechanical breakup. River flow during the breakup period was similar to freezeup in December. Therefore, the threshold condition for mechanical breakup (a differential increase of about 3,500 cfs between freezeup and breakup), was never met. Based on photographs and field observations during the breakup period, it can be concluded that no ice run/jam occurred in the lower Grasse River during the Spring 2006 ice breakup. This conclusion is further supported by stage height data at Alcoa Outfall 001, which did not indicate any unusual spikes in river stage that would correlate to an ice jam in the lower river.

During the Spring 2006 ice breakup monitoring period, samples were collected for analysis of total suspended solids (TSS), as described in the Work Plan (Alcoa, December 2005). TSS results will be discussed in the 2006 Data Summary Report, along with other water quality sampling results for the 2006 calendar year.

8.0 References

Comprehensive Characterization of the Lower Grasse River (Alcoa, 2001)

Draft Addendum to the Comprehensive Characterization of the Lower Grasse River
(Alcoa, April 2004)

2005/2006 Grasse River Ice Monitoring Work Plan (Alcoa, December 2005)

*Technical Memorandum-Grasse River Project 2004/2005 River Ice Monitoring
Documentation Summary* (Alcoa, December 2005, Revised April 2006)

Tables

| Location Number | Ice Monitoring Location | Road Designation | Approximate 1992 Sediment Probing Transect Number ¹ |
|-----------------|-------------------------------|------------------|--|
| 1 | Amvets Property | --- | 66 |
| 2 | Haverstock Road | --- | 54 |
| 3 | Massena Center | --- | 28 |
| 4 | Route 131 Bridge | Route 131 | 22 |
| 5 | Capping Pilot Study Area | --- | 16 |
| 6 | Outfall 001 | --- | 5 |
| 7 | Alcoa Bridge | Alcoa Road | 2 |
| 8 | Parker Street Bridge | Route 37B | --- |
| 9 | Main Street Bridge | Route 420 | --- |
| 10 | Route 37 Bridge | Route 37 | --- |
| 11 | Massena Rod and Gun Club | --- | --- |
| 12 | Louisville Bridge | Route 39 | --- |
| 13 | Chase Mills Bridge, USGS Gage | Route 36 | --- |
| 14 | Chamberlain Corners Bridge | Route 44 | --- |
| 15 | Madrid Bridge | Route 345 | --- |

Notes:

1. See Figure 11 for transect locations.

Table 1
Grasse River Ice Monitoring Locations

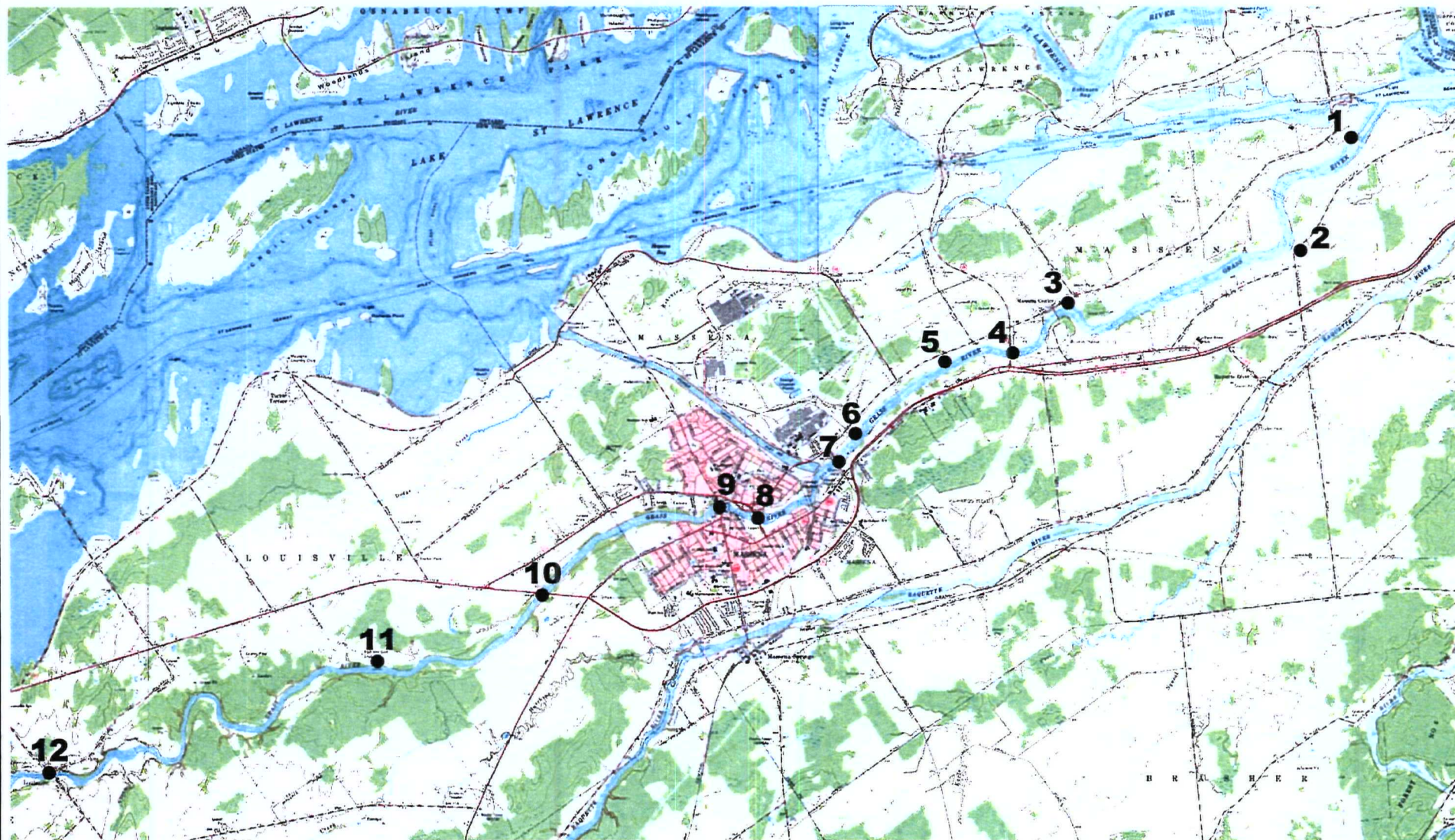
| Location | Position ¹ | Thickness (Inches) |
|-------------------------------|-----------------------|--------------------|
| Location 1 (Amvets) | Left | 17.5 |
| | Center | 16.0 |
| | Right | 16.0 |
| | Average | 16.5 |
| Location 4 (Route 131 Bridge) | Left | 13.5 |
| | Center | 11.5 |
| | Right | 16.0 |
| | Average | 13.7 |
| Location 6 (Outfall 001) | Left ² | 13.0 |
| | Center | 19.5 |
| | Right | 19.0 |
| | Average | 19.3 |
| Lower Grasse River | Max | 19.5 |
| | Min | 11.5 |
| | Average | 16.1 |
| | | |
| Location 10 (Route 37 Bridge) | Left | 16.0 |
| | Center | 17.0 |
| | Right | 18.5 |
| | Average | 17.2 |
| Location 15 (Madrid Bridge) | Left | 11.5 |
| | Center | 13.0 |
| | Right | 12.0 |
| | Average | 12.2 |
| Upper Grasse River | Max | 18.5 |
| | Min | 11.5 |
| | Average | 14.7 |

Notes:

1. River position when looking downstream.
2. Not used to calculate average due to warmer water influence from Outfall 001.

Table 2
Grasse River Ice Thickness Measurements
March 3, 2006

Figures



**OTHER MONITORING LOCATIONS UPSTREAM OF
LOUISVILLE BRIDGE, MONITORING LOCATION 12**

| No. | LOCATION | DISTANCE UPSTREAM* |
|-----|------------------------------------|-----------------------|
| 13 | CHASE MILLS BRIDGE, RT. 36 | 5 ml |
| 14 | CHAMBERLAIN CORNERS BRIDGE, RT. 44 | 6.75 ml |
| 15 | MADRID BRIDGE, RT. 345 | 12 ml |

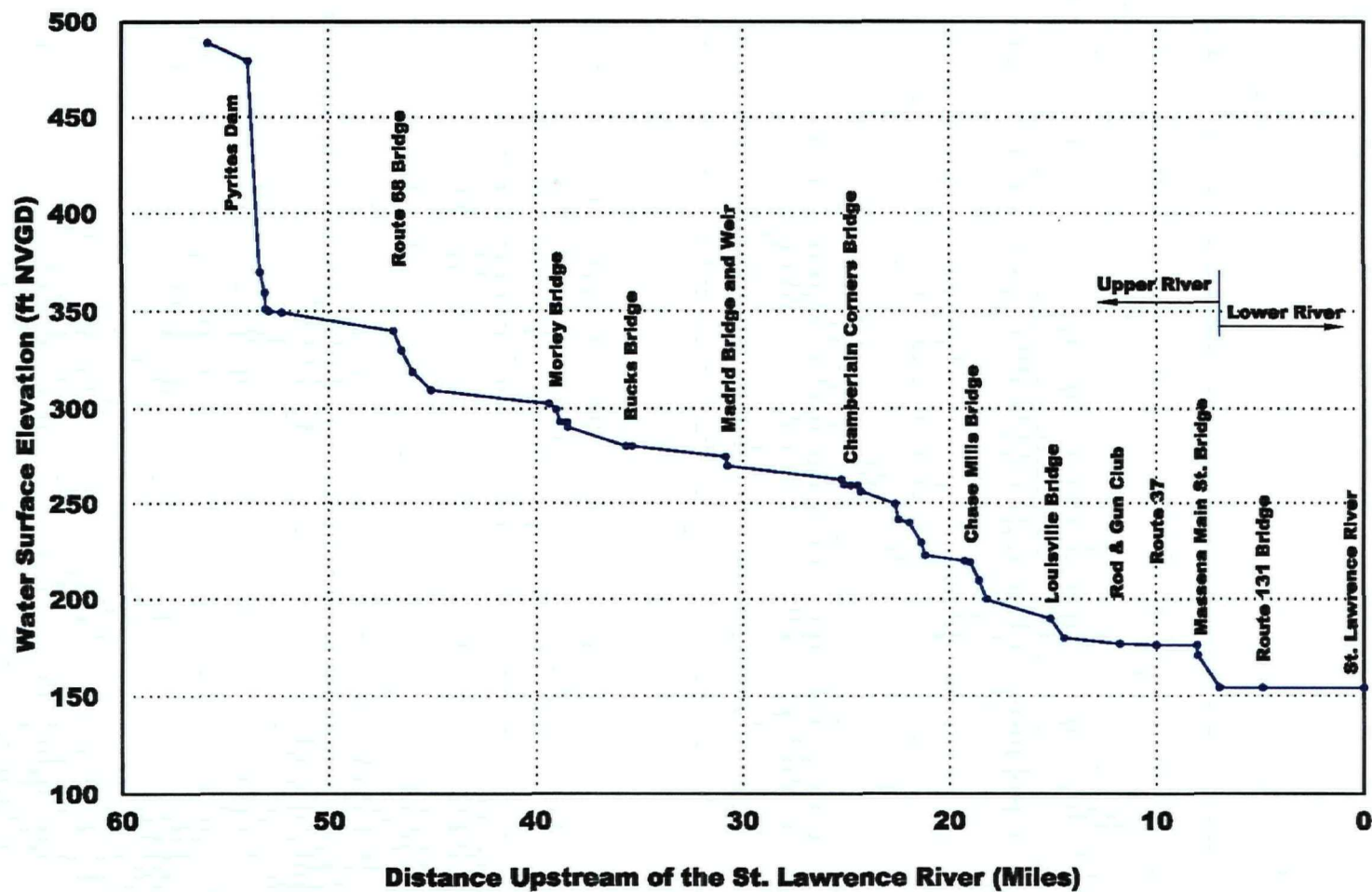
* ALL DISTANCES ARE REFERENCED FROM LOUISVILLE
BRIDGE AND ARE APPROXIMATE.

**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**2005/2006 GRASSE RIVER
ICE MONITORING LOCATIONS**



**FIGURE
1**



Note:

1. Water surface elevations obtained from USGS 7.5 minute series topographic quadrangles.

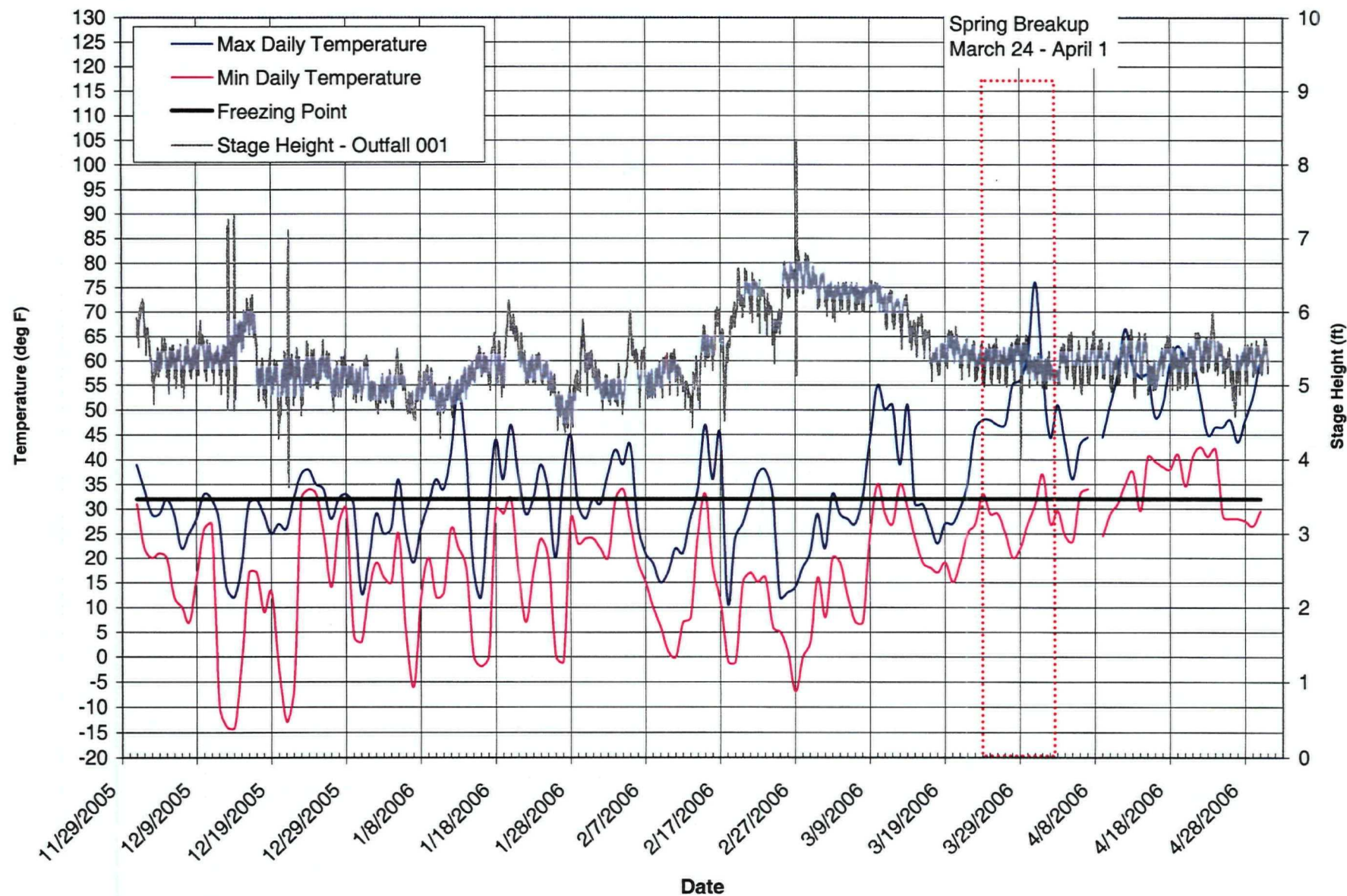
**GRASSE RIVER STUDY AREA
MASSENA, NEW YORK**

**TYPICAL WATER SURFACE
ELEVATION**



FIGURE

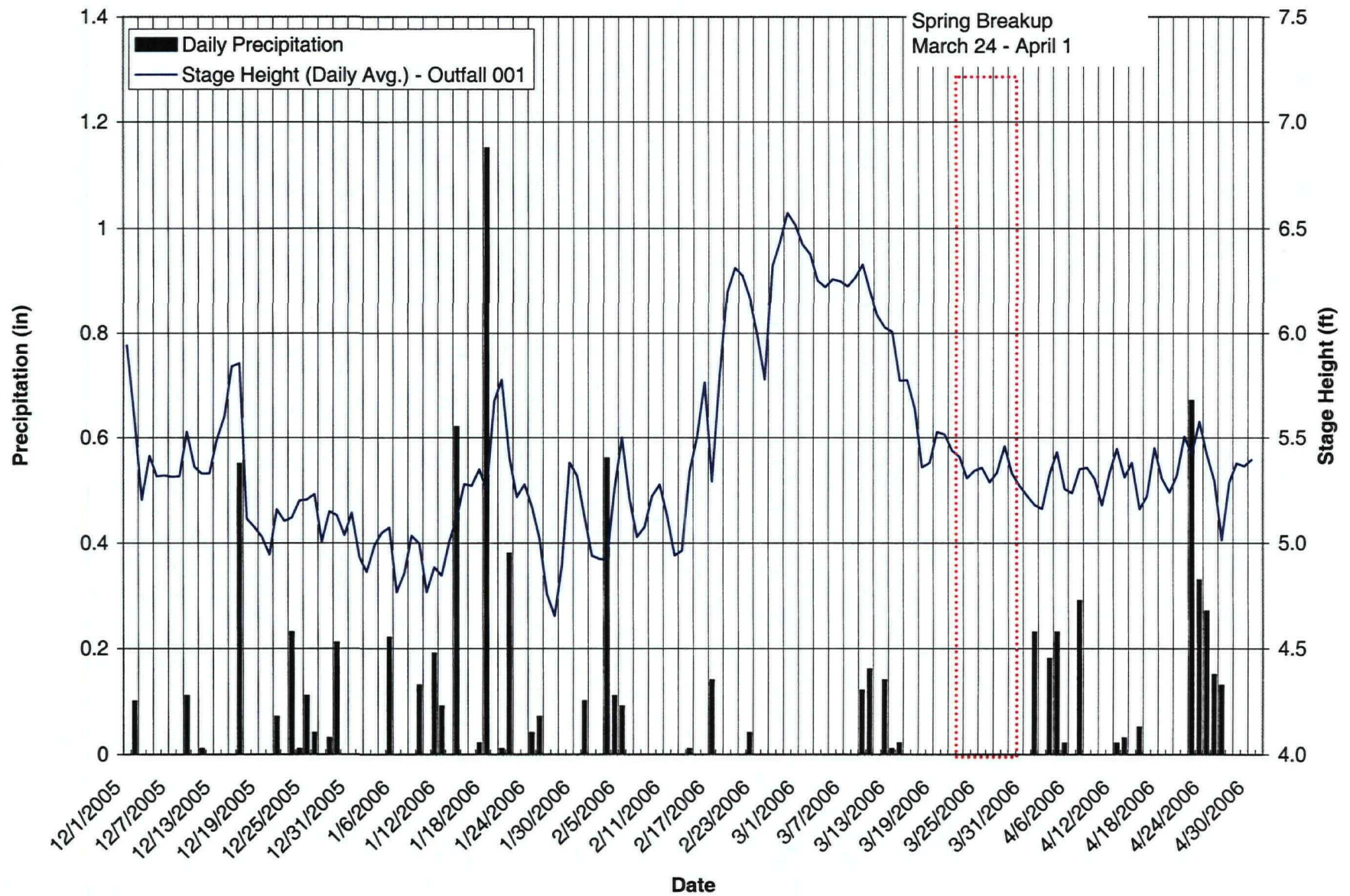
2



Note:

- Relative stage height of 0.0 feet corresponds to 150.0 feet USLS
- Temperature data from Massena International Airport

Figure 3
Air Temperature and Stage Height for Winter 2005/2006
Massena, New York



Note:
 - Relative stage height of 0.0 feet corresponds to 150.0 feet USLS
 - Precipitation data from Massena International Airport

Figure 4
Precipitation Data and Stage Height for Winter 2005/2006
Massena, New York

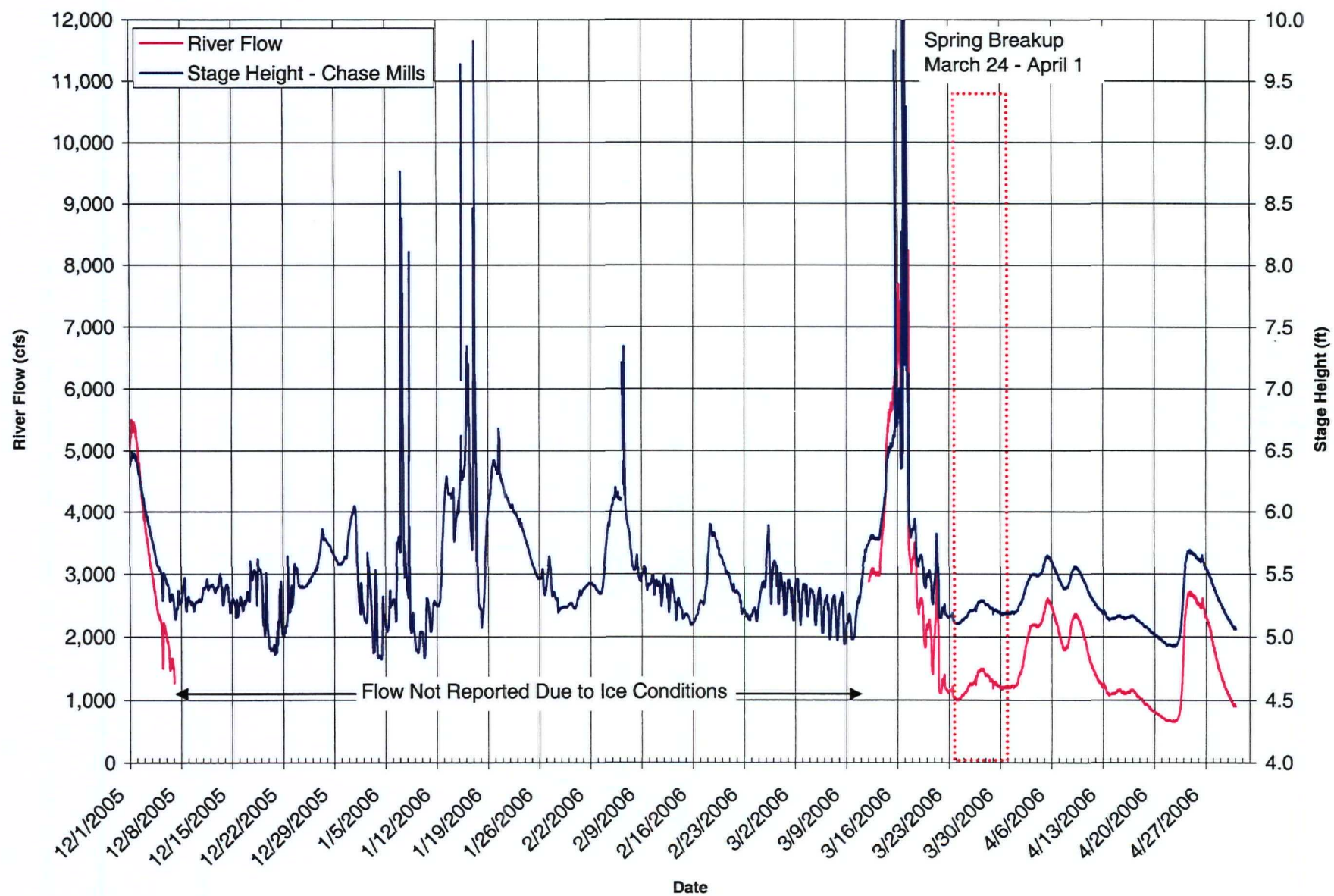
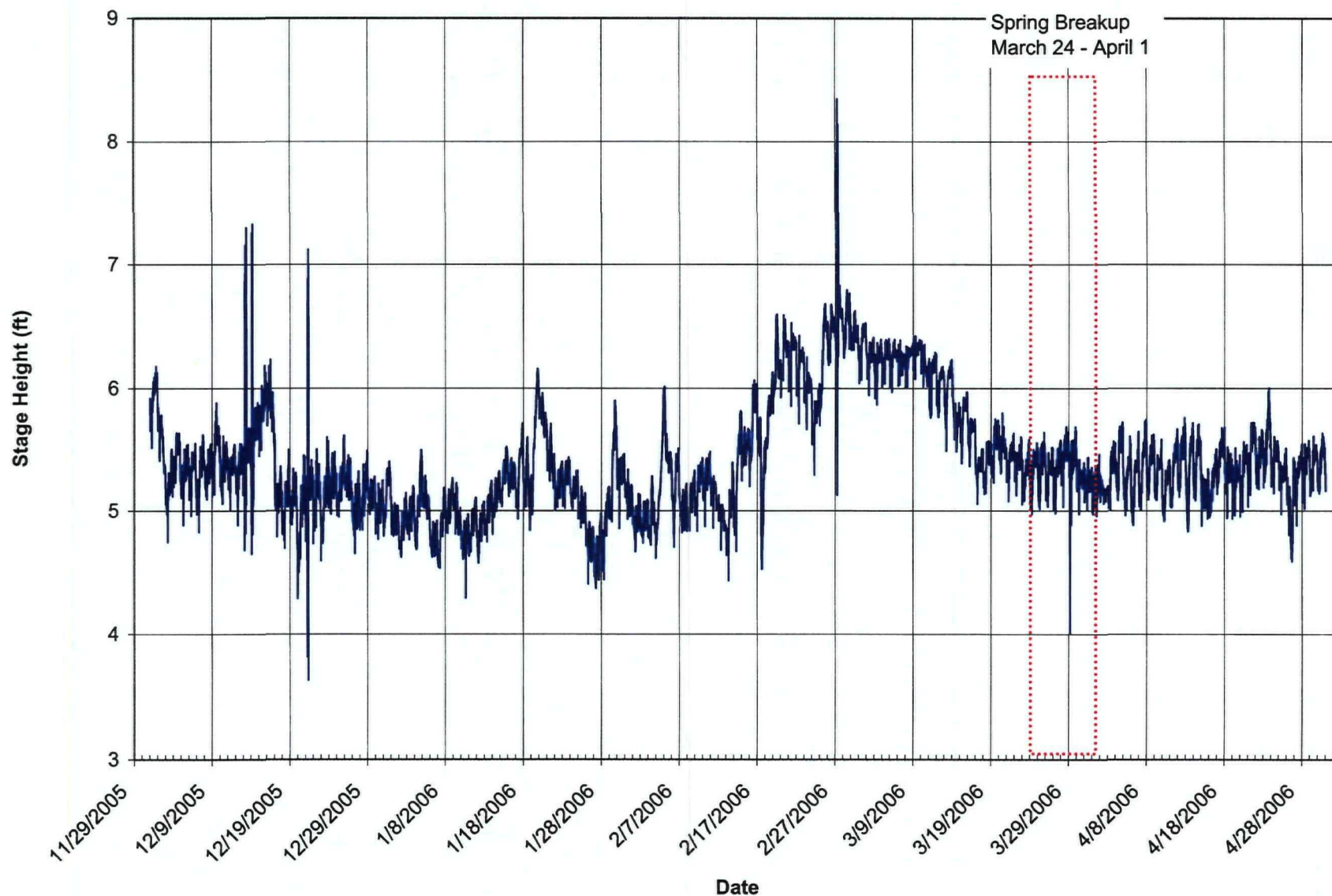


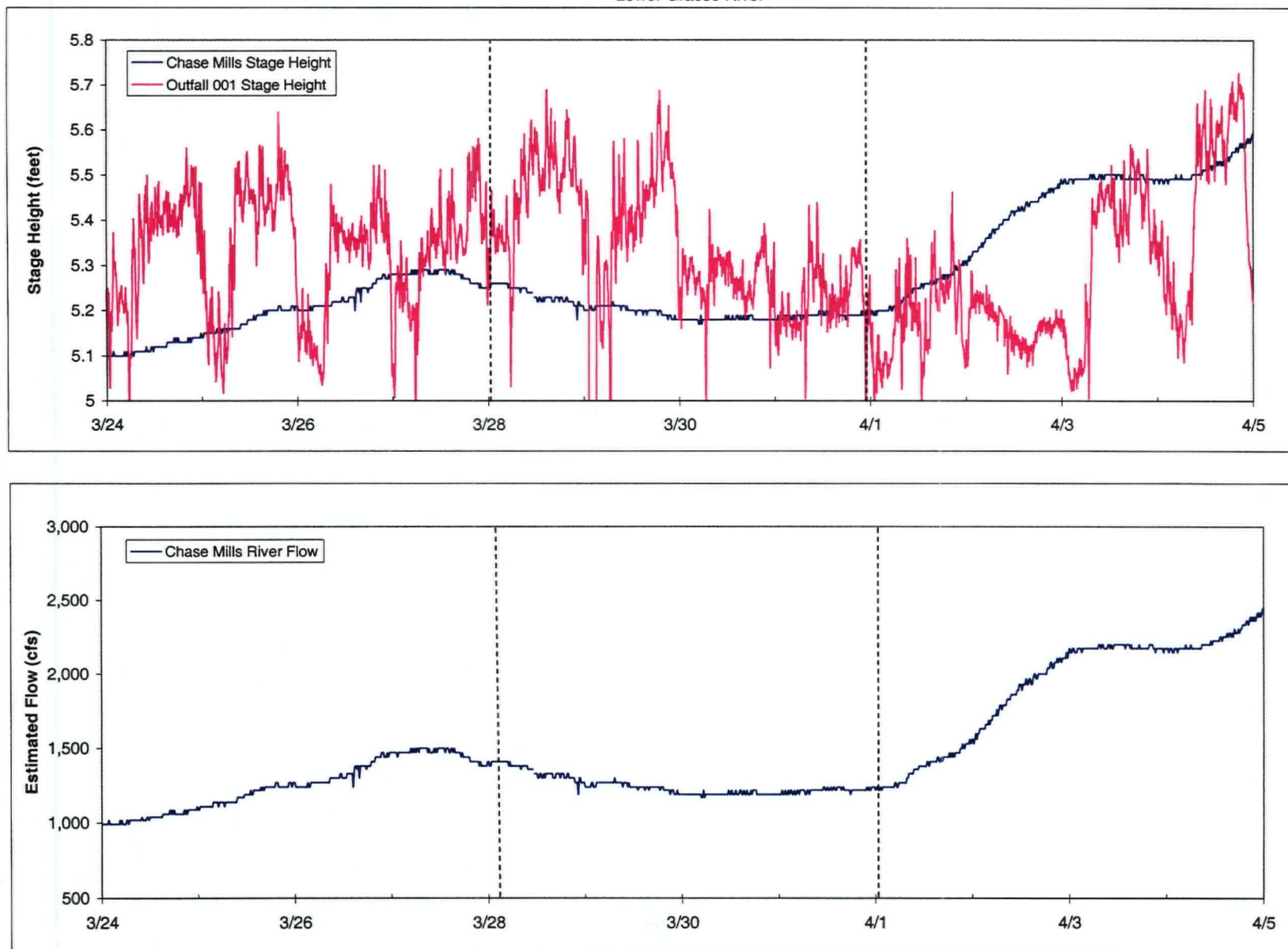
Figure 5
Grasse River Stage Height and Flow for Winter 2005/2006
Chase Mills, New York USGS Gaging Station



Note:
Relative stage height of 0.0 feet corresponds to 150.0 feet USLS

Figure 6
Grasse River Stage Height for Winter 2005/2006
Alcoa Outfall 001 Staff Gage - Massena, New York

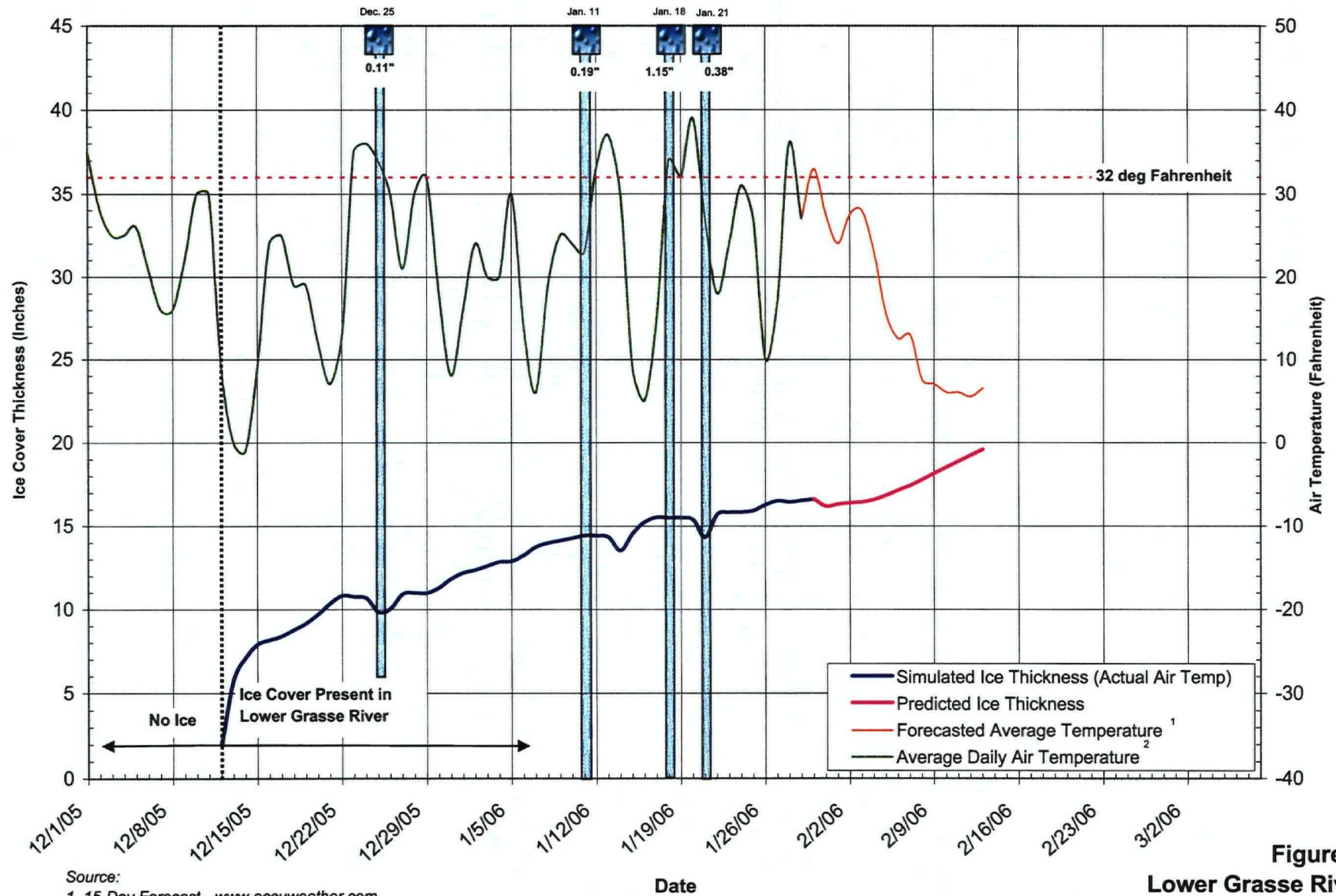
Approximate Time of
Ice Meltout and
Clearing from the
Lower Grasse River



Notes:

- Real-time stage height and flow data were collected from the USGS website for the gaging station at Chase Mills, NY (#04265432)
- Real-time stage height data were collected from the staff gage at the Alcoa Outfall 001 in Massena, NY.

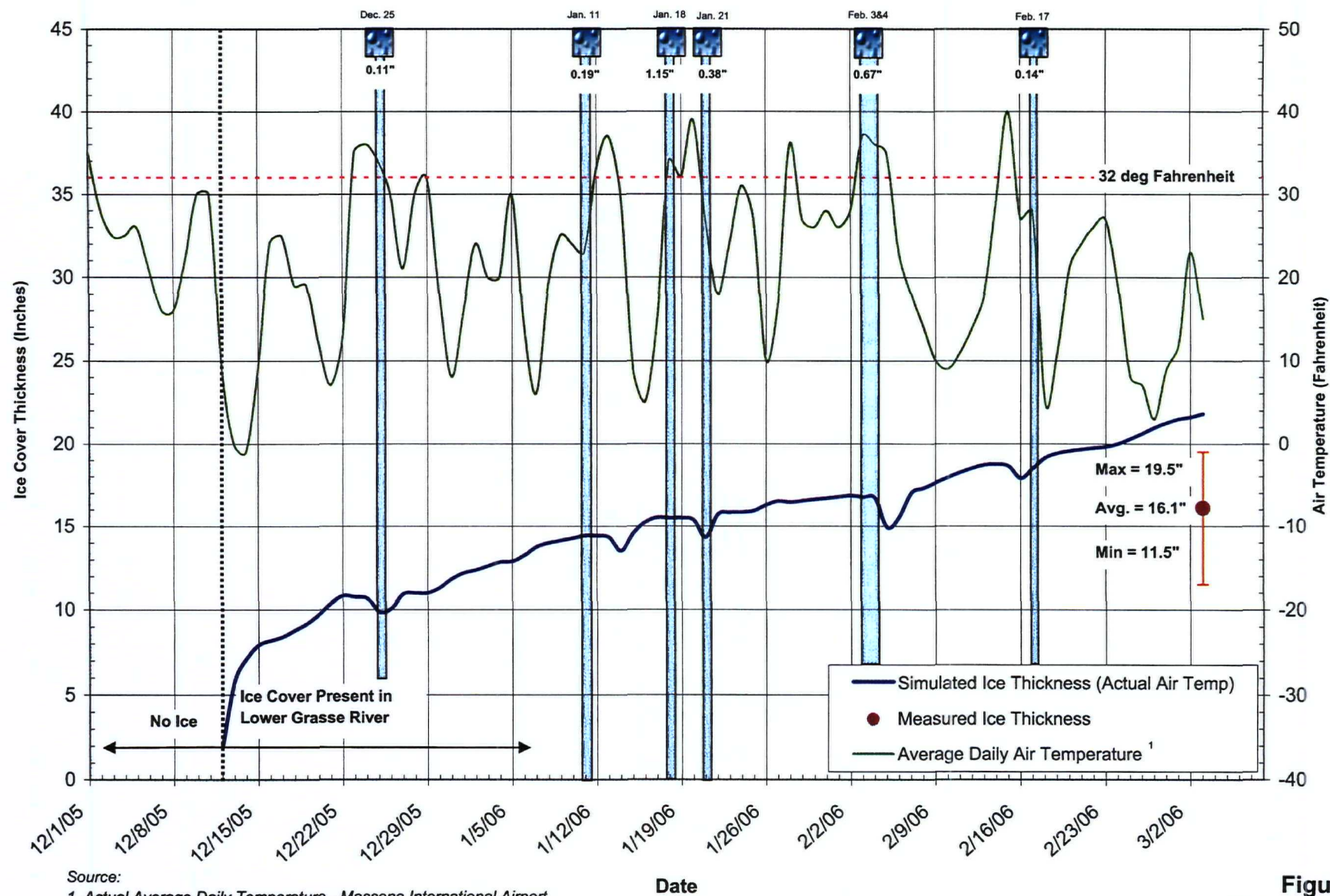
Figure 7
Stage Height and Flow for the Spring 2006 Ice Breakup
Chase Mills USGS Gage and Outfall 001 Staff Gage



Source:

1. 15-Day Forecast - www.accuweather.com
2. Actual Average Daily Temperature - Massena International Airport
3. Model Provided by Clarkson University

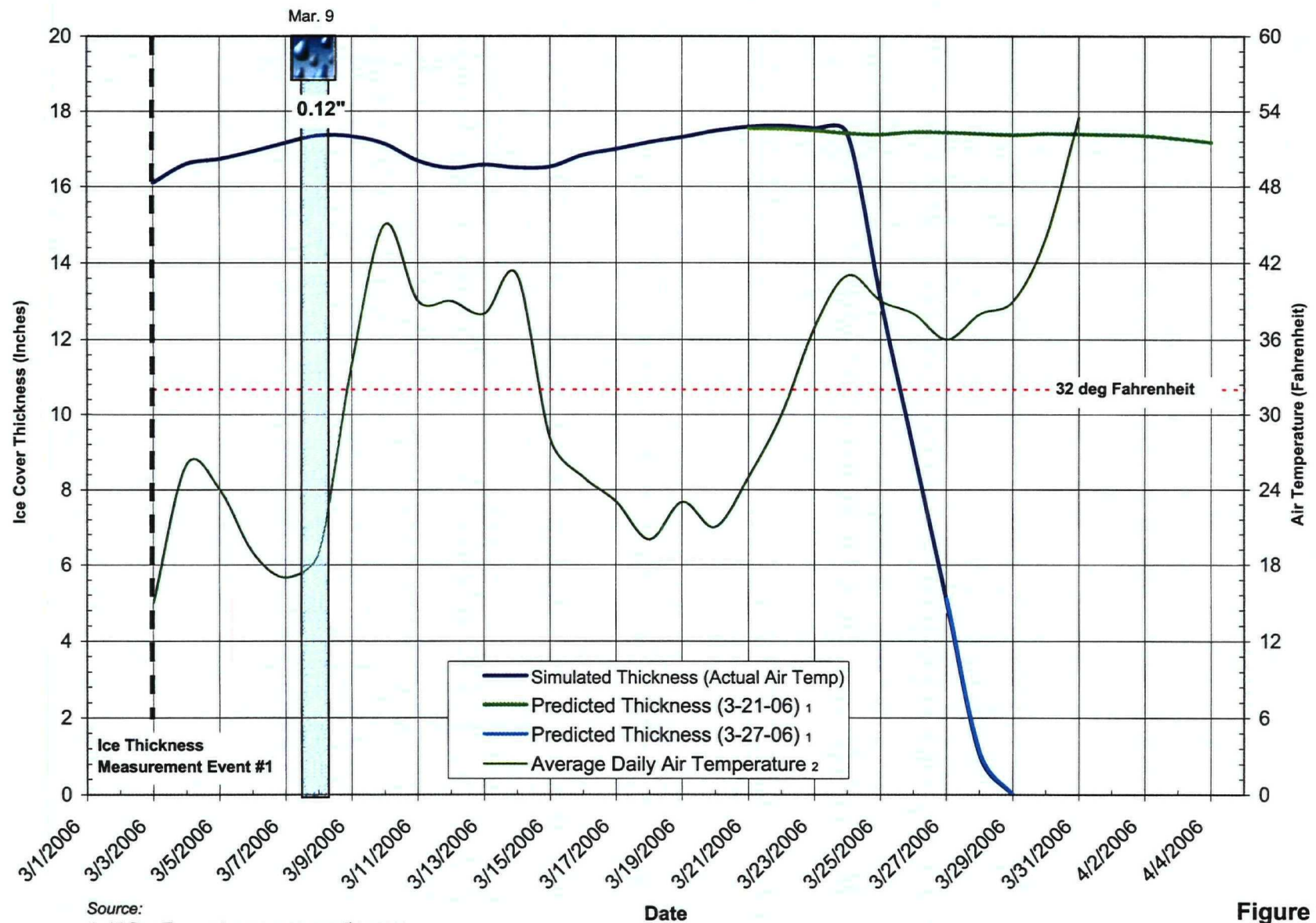
Figure 8
Lower Grasse River
Ice Thickness Forecasting Model
Simulated Thickness and 15-Day Forecast
January 30, 2006



Source:

1. Actual Average Daily Temperature - Massena International Airport
2. Model Provided by Clarkson University

Figure 9
Lower Grasse River
Ice Thickness Forecasting Model
Simulated Thickness Through March 3, 2006

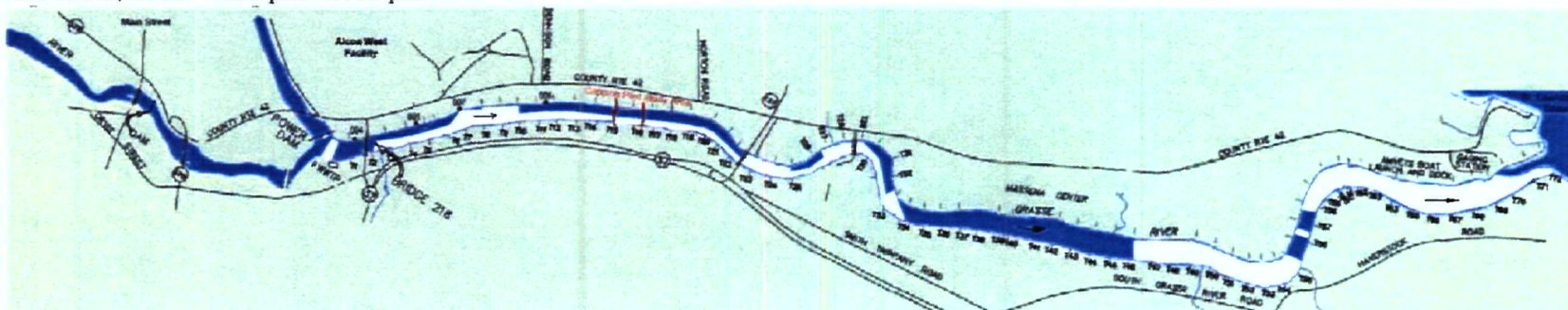


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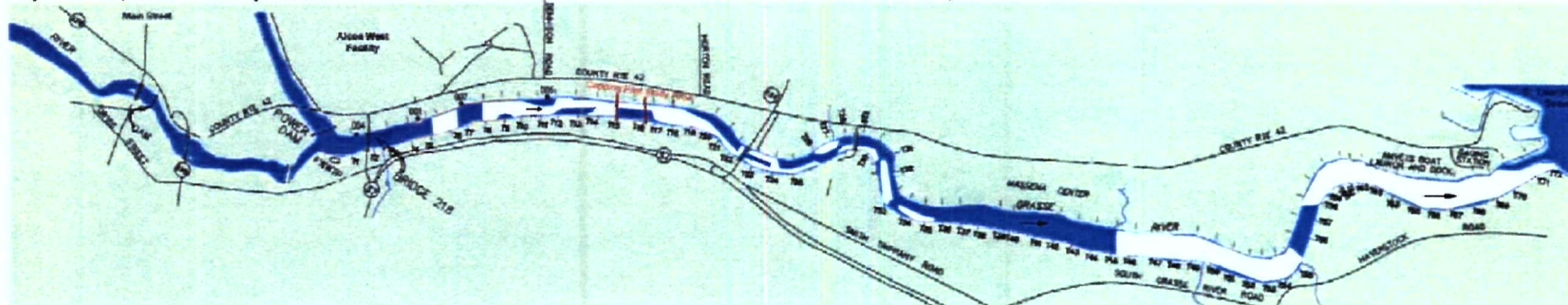
1. 15-Day Forecast - www.accuweather.com
2. Actual Average Daily Temperature - Massena International Airport
3. Model Provided by Clarkson University

Figure 10
Lower Grasse River
Ice Thickness Forecasting Model
Simulated and Predicted Thickness Through Breakup

March 28, 2006 1:00 pm - 3:00 pm



March 29, 2006 10:00 am - 11:00 am



March 29, 2006 2:30 pm - 3:30 pm

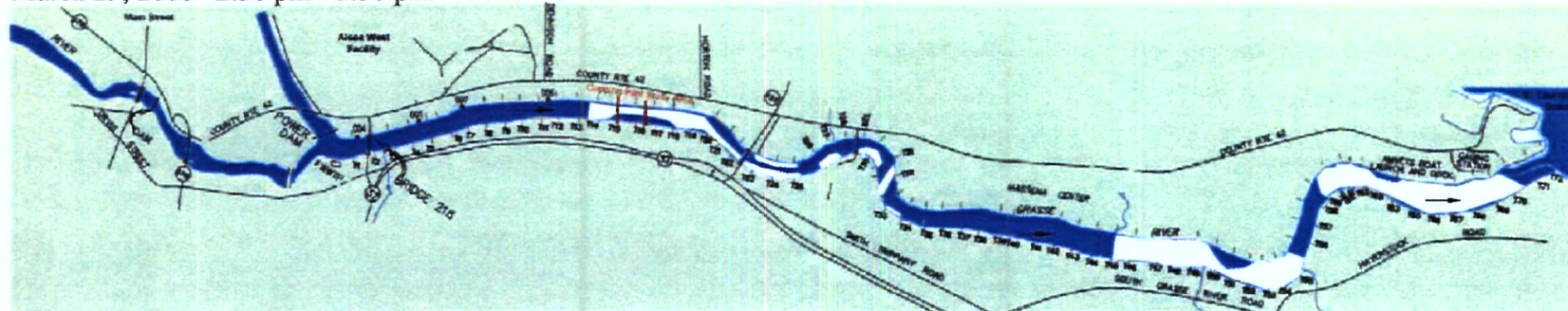
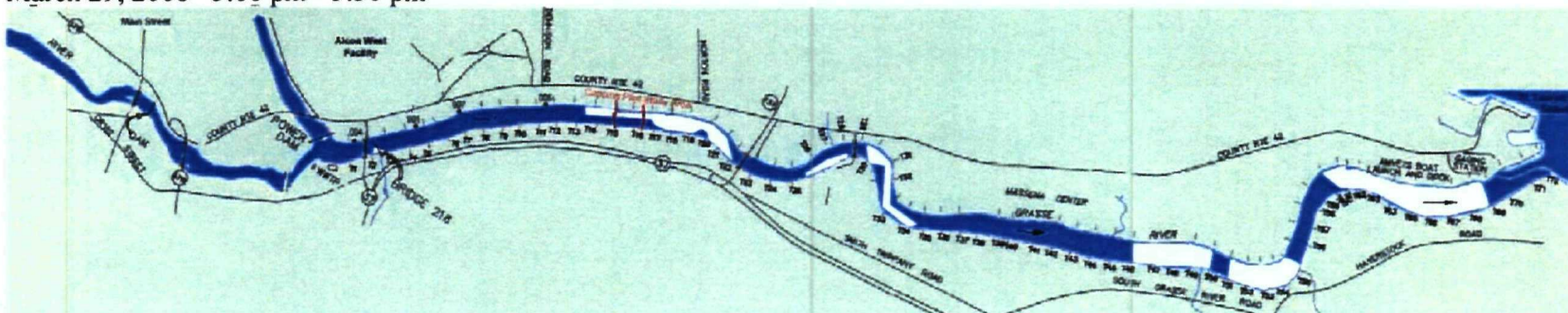
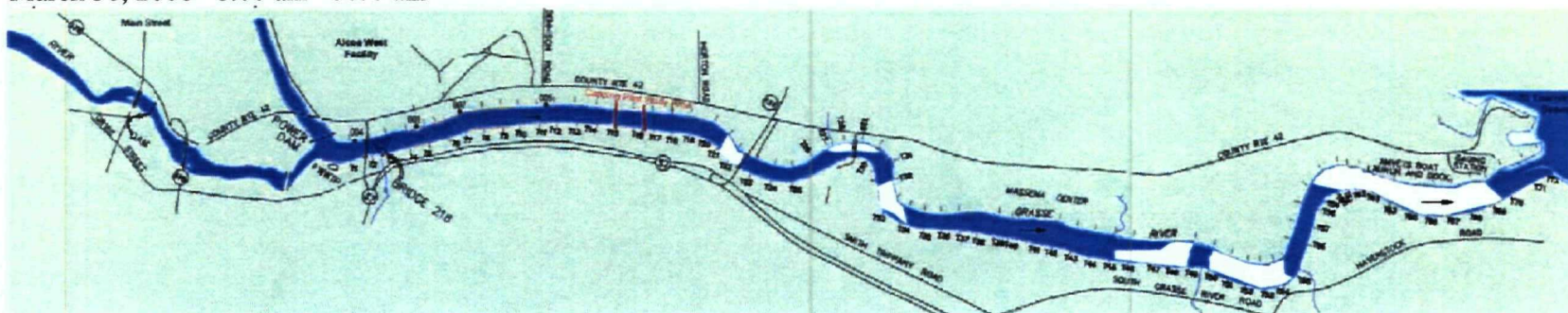


Figure 11
Lower Grasse River
Approximate Location of Ice Cover
March 28 - 30, 2006

March 29, 2006 5:00 pm - 5:30 pm



March 30, 2006 8:00 am - 9:00 am



March 30, 2006 5:00 pm

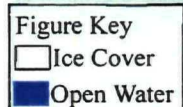
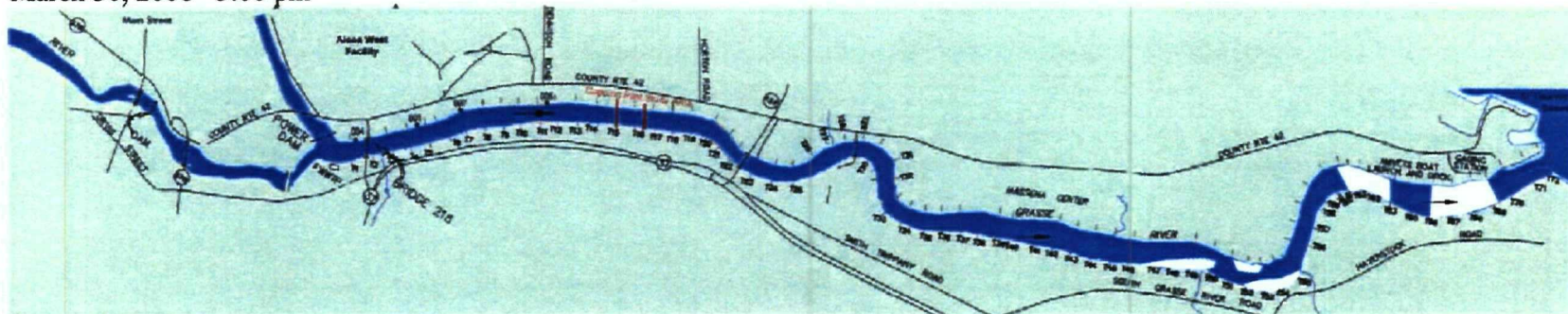


Figure 11
Lower Grasse River
Approximate Location of Ice Cover
March 28 - 30, 2006

Figure 12a: Ice very thin and melting downstream of Alcoa Bridge (Location 7)



Figure 12b: Ice thin and open downstream of the Rte. 131 Bridge (Location 4)



Figure 12c: Ice debris accumulates upstream of Rte. 131 Bridge (Location 4)



Figure 12
Lower Grasse River
Photographs During 2005/2006 Ice Breakup

Figure 12d: Some ice sheets float past Massena Center (Location 3)



Figure 12e: Ice cover thin but spanned the Grasse River at Amvets (Location 1)



Figure 12f: Minimal remaining thin ice cover upstream of Amvets (Location 1)



Figure 12
Lower Grasse River
Photographs During 2005/2006 Ice Breakup

Attachment A

Photo Library – Winter 2005/2006 River Ice Monitoring (CD)

Video Documentation of Lower Grasse River Ice Breakup,
March 28 - 31, 2006 (DVD)

ELECTRONIC RECORD TARGET SHEET

| | |
|---|--|
| SITE NAME: | ALCOA AGGRAGATION SITE |
| CERCLIS ID: | NYD980506232 |
| SDMS DOC ID: | 113227 |
| ALT. MEDIA TYPE: | DVD |
| DOCUMENT FORMAT: | VIDEO |
| NATIVE FORMAT LOCATION/FILENAME: | APPENDIX B - 2005/2006 RIVER ICE MONITORING, VIDEO OF ICE BREAKUP MARCH 28-31, 2006 GRASSE RIVER (D:) |
| COMMENTS: | VIDEO CAN BE VIEWED IN THE SUPERFUND RECORDS CENTER, 290 BROADWAY, 18TH FLOOR, NYC 10007 |

Attachment B

ELECTRONIC RECORD TARGET SHEET

| | |
|-------------------|------------------------|
| SITE NAME: | ALCOA AGGRAGATION SITE |
|-------------------|------------------------|

| | |
|--------------------|--------------|
| CERCLIS ID: | NYD980506232 |
|--------------------|--------------|

| | |
|---------------------|--------|
| SDMS DOC ID: | 113227 |
|---------------------|--------|

| | |
|-------------------------|-----|
| ALT. MEDIA TYPE: | DVD |
|-------------------------|-----|

| | |
|-------------------------|-------|
| DOCUMENT FORMAT: | VIDEO |
|-------------------------|-------|

| | |
|---|---|
| NATIVE FORMAT LOCATION/FILENAME: | APPENDIX B - 2005/2006 RIVER ICE MONITORING, PHOTOGRAPHIC DOCUMENTATION D:\12-15-05 07 U ice formation 2.MPG |
|---|---|

| | |
|------------------|--|
| COMMENTS: | VIDEO CAN BE VIEWED IN THE SUPERFUND RECORDS CENTER, 290 BROADWAY, 18TH FLOOR, NYC 10007 |
|------------------|--|

MEMO FOR RECORD

SUBJECT: Grasse River Ice Conditions

DATE: March 24, 2006

Andy Tuthill made an aerial survey of ice conditions on the Grasse River, from its mouth upstream to Canton, NY on March 24, 2006. In general, the river was about 80% ice-covered for its lowermost 20 miles. Most of this ice cover consists of decaying sheet ice, varying in color from whitish to dark, and the ice does not appear to be very thick or very strong. Rapids, and sections of faster-moving water were open. The red lines in Figs. 1 and 2 show the stretches of river that were ice-covered on 3/24/06. From about 0.5 miles below the Bucks Bridge, the Grasse River was open upstream beyond the village of Canton.

A selection of aerial photos located on the CRREL ftp site illustrate the general condition of the ice cover. The jpeg file names indicate photo locations.

<ftp://ftp2.erdc.usace.army.mil/pub/crl/Tuthill/GrasseRiverPhotos/>

Fig. 3 compares air temperatures at Syracuse to long-term averages, showing the winter of 2006 to be quite mild.

Barring occurrence of an extremely dynamic, rainfall-triggered breakup event, there does not appear to be sufficient ice volume in the upper river to supply a severe ice jam in the lower river.

Respectfully Submitted,

Andrew M. Tuthill, P. E.
Ice Engineering Group
Remote Sensing/ GIS Branch
US Army Engineer Research and Development Center
Cold Regions Research and Engineering Laboratory
72 Lyme Rd.
Hanover, NH 03755

603-646-4225 phone 4477 fax

SEE ATTACHMENT A FOR COMPLETE LIBRARY OF MARCH 24, 2006 AERIAL PHOTOS

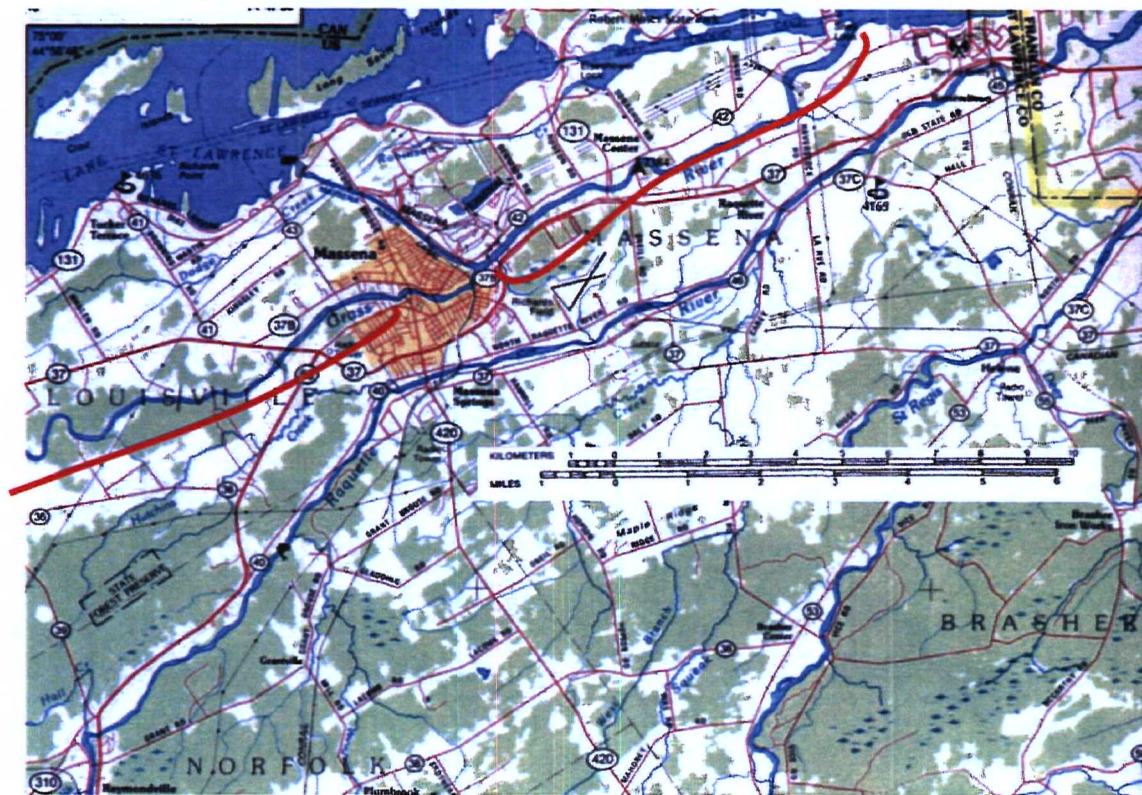
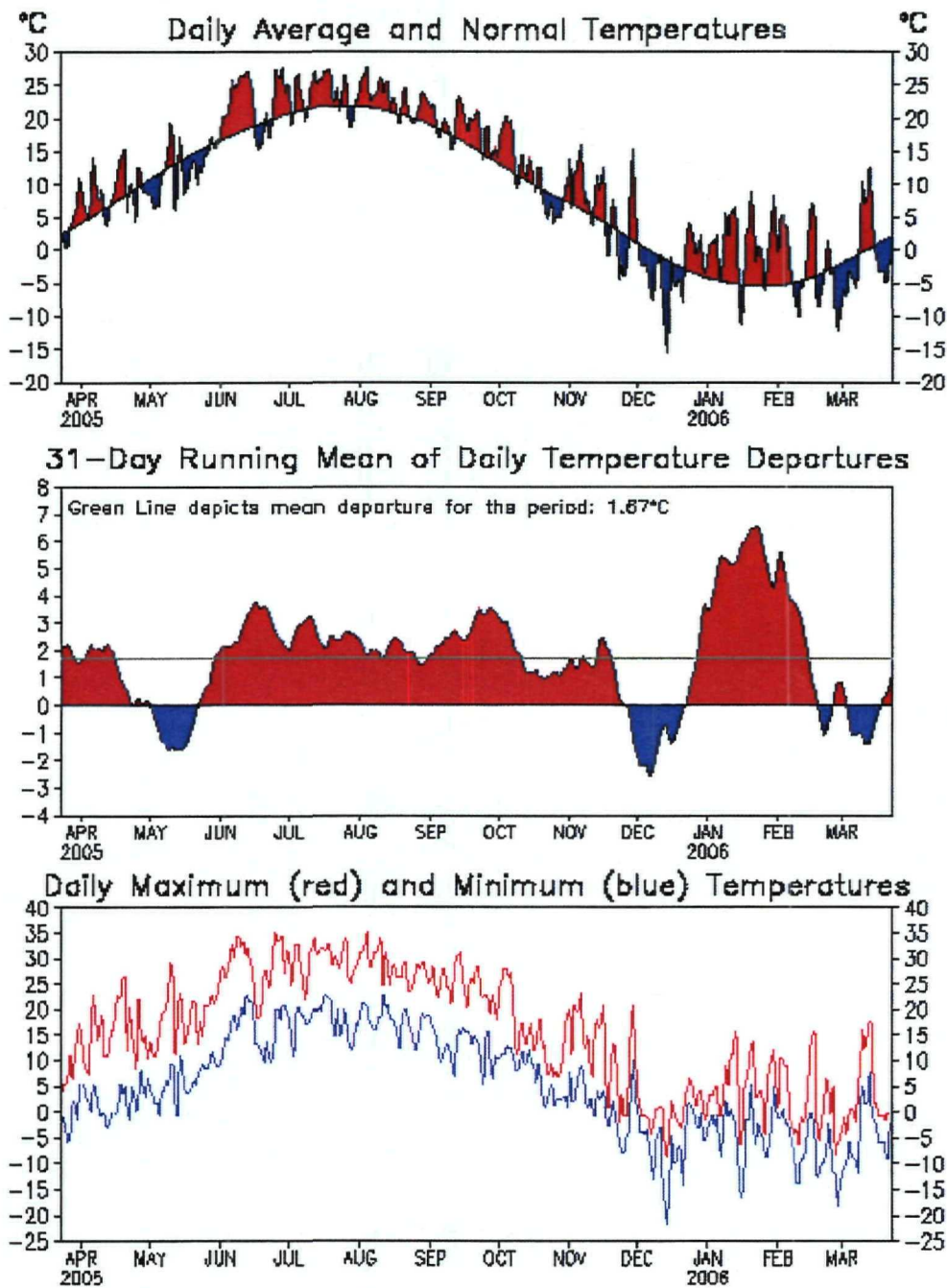


Fig. 1. Lower portion of the Grasse River. Red lines indicate extent of ice cover.



Fig. 2. Grasse River from Louisville upstream to Canton. Red lines indicate extent of ice cover.

SYRACUSE, NEW YORK



Data updated through 22 MAR 2006

CLIMATE PREDICTION CENTER/NCEP

Fig. 3. Winter air temperature at Syracuse, NY, compared to long-term averages.

Friday, March 24, 2006



Lower Grasse River

Friday, March 24, 2006



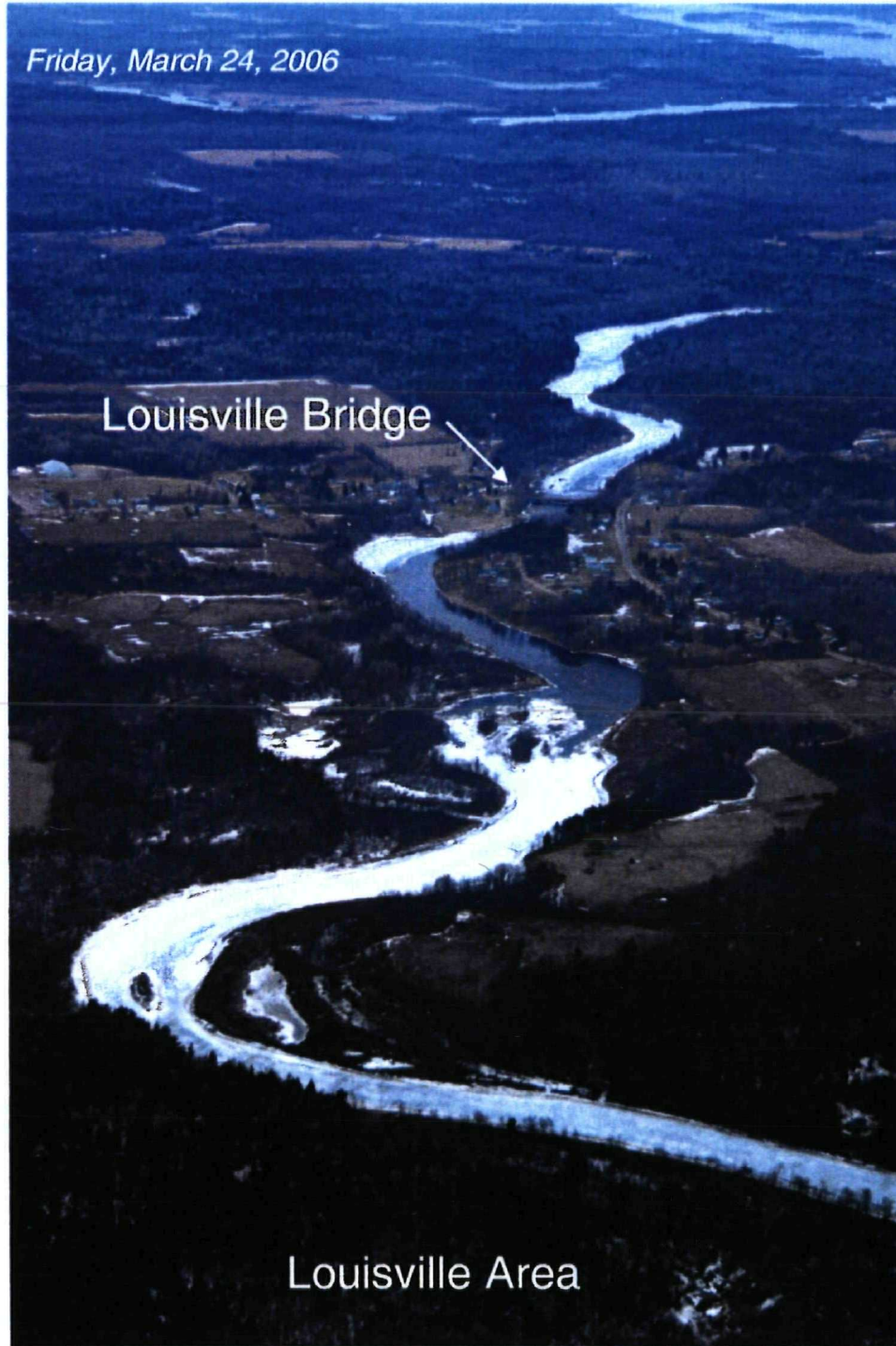
Downtown Massena, NY

Friday, March 24, 2006

Louisville Bridge



Louisville Area



**INSERT
DOCUMENT
HERE**